Fundamental Tidy Data Science in R

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- Sensory Scientist @ Sensolution.ID
- Using R for 4+ years, keen on Data Carpentry
- Initiator of Komunitas R Indonesia
- 📦: sensehubr, nusandata, bandungjuara, prakiraan, etc
- 🖥️: sensehub, thermostats, aquastats, bcrp, bandungjuara, etc

aswansyahputra

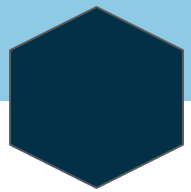
Know your neighbour!

- Who are you?
- What you do with data?
- How would you describe your experience with R?

Our goal

Artwork by @allison_horst

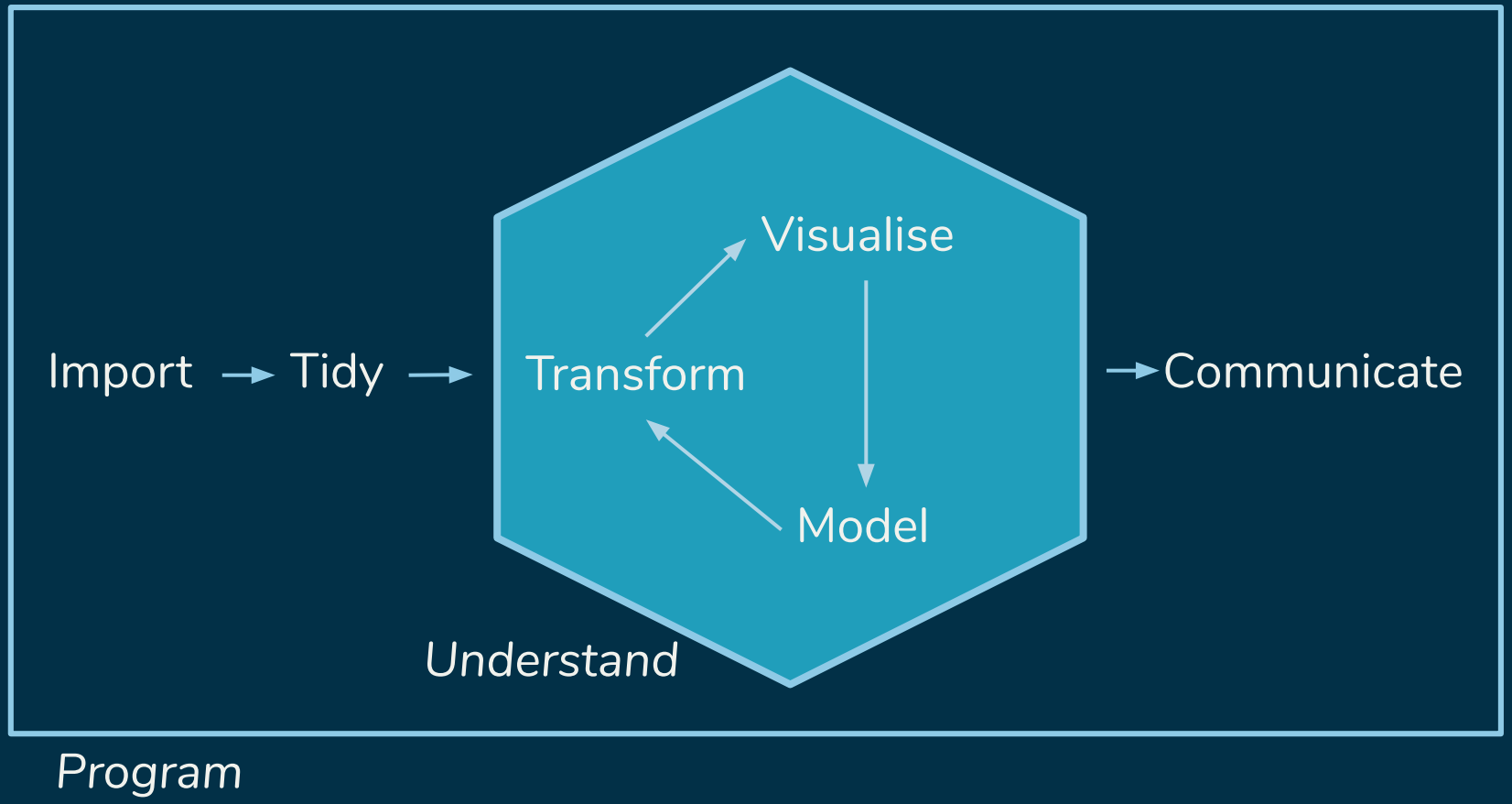
Meet the assistants



Naviz

William

Data science is the art of turning raw data into understanding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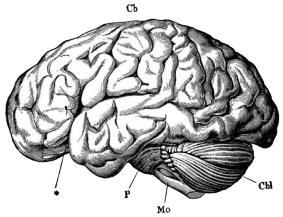
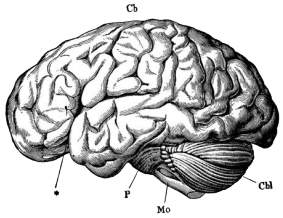


Human thought ⟷ Machine Language

Source: https://github.com/rstudio-education/arm-workshop-rsc2019



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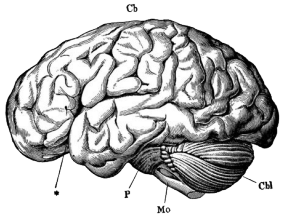

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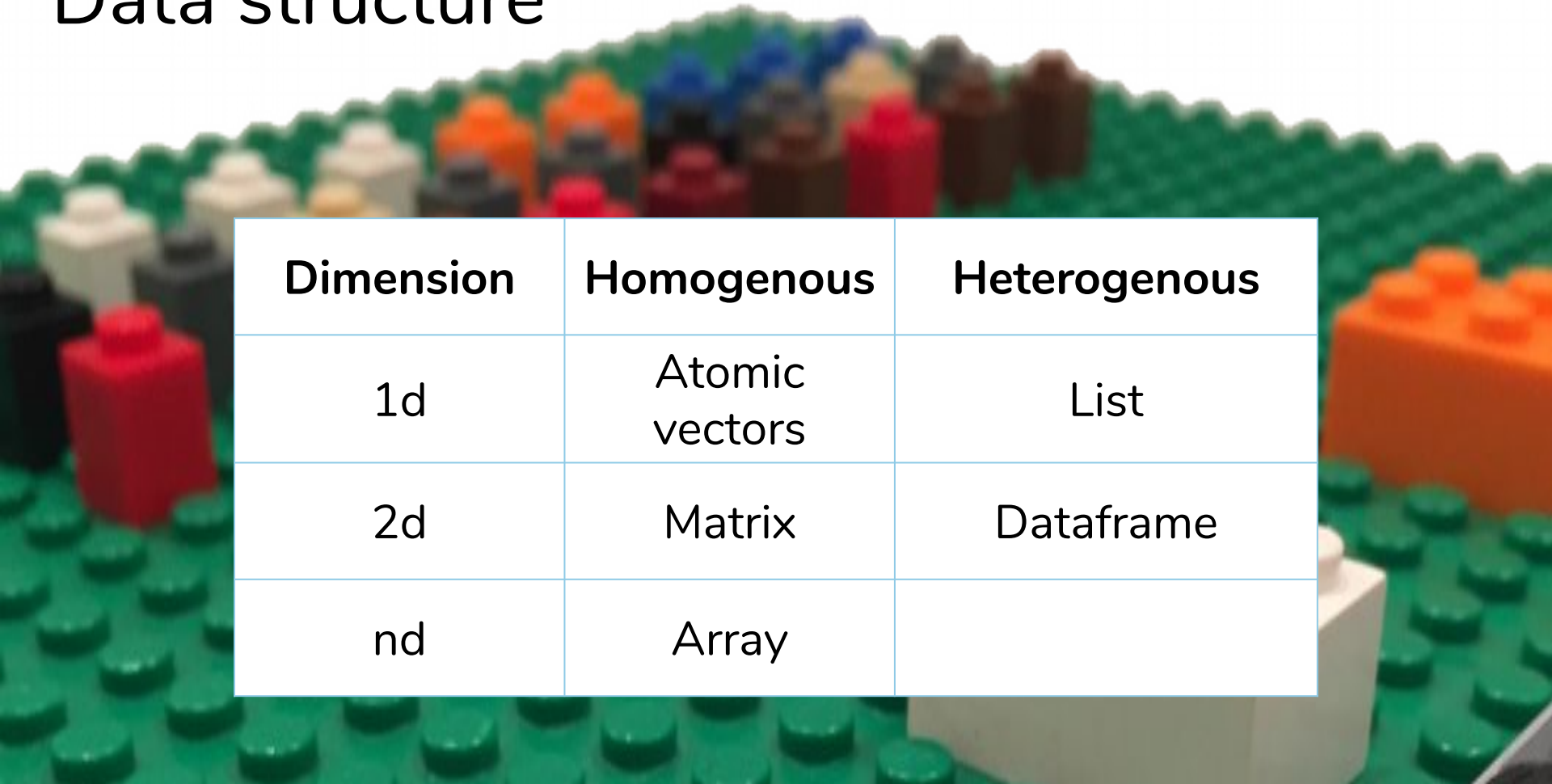
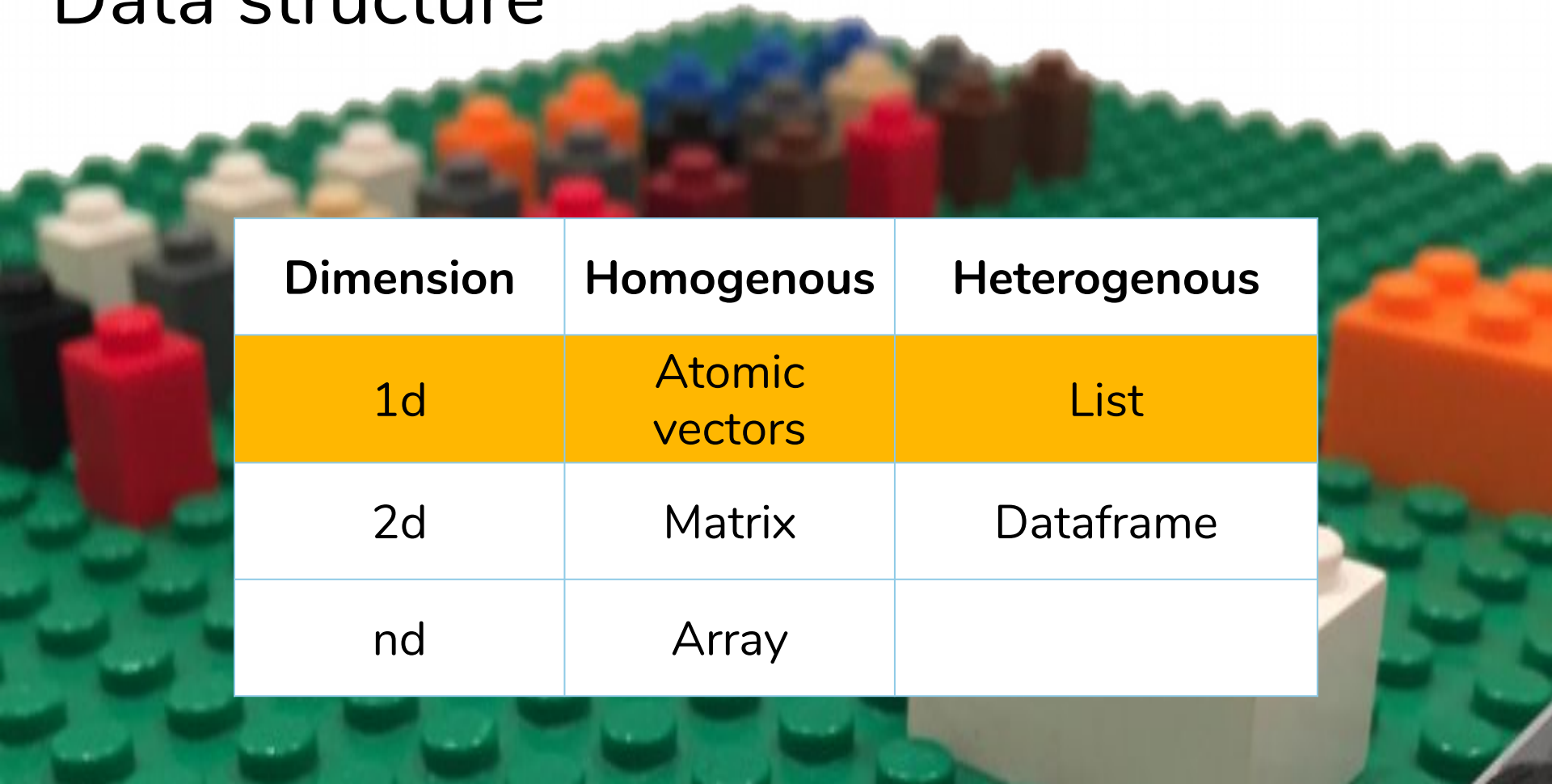
Data structure



Dimension	Homogenous	Heterogenous
1d	Atomic vectors	List
2d	Matrix	Dataframe
nd	Array	

Data structure



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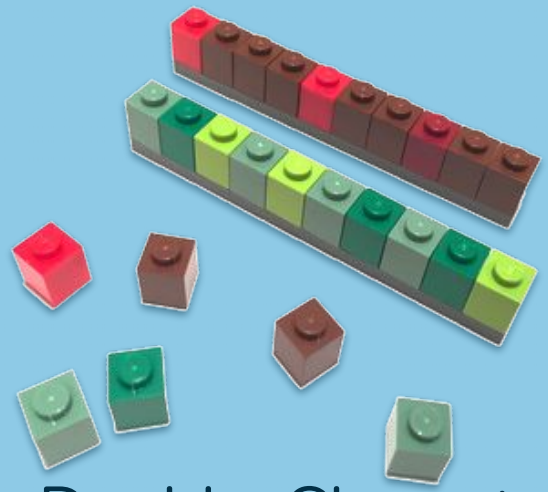
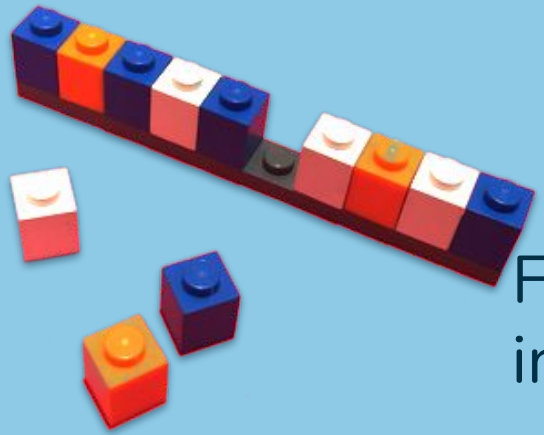


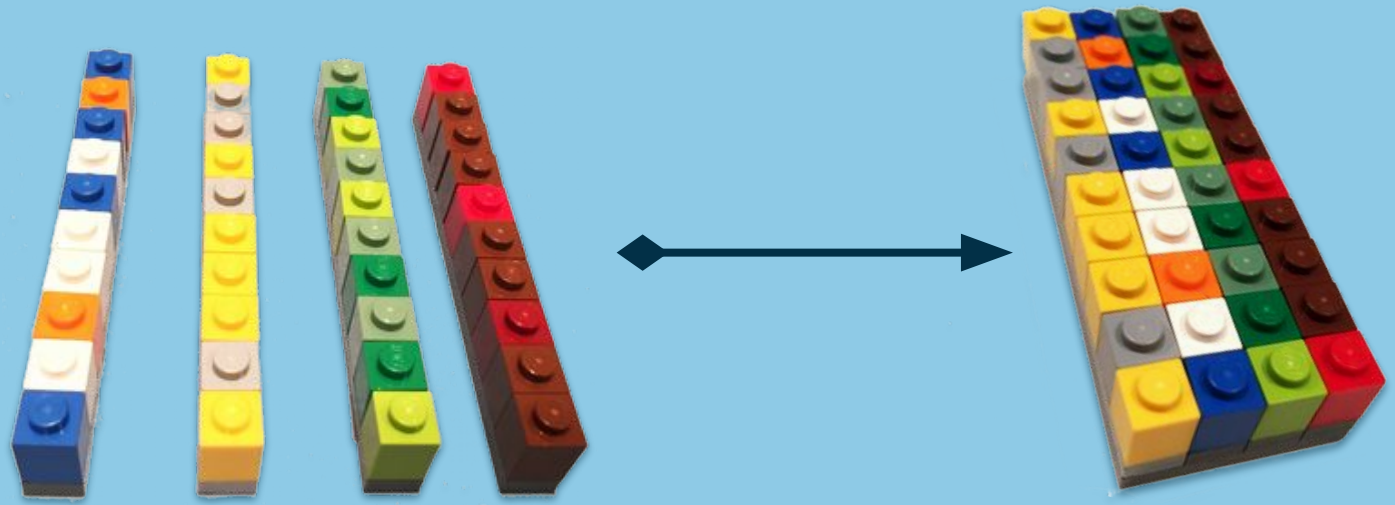
Integer, Double, Character

Logical



Factor (basically integer with class)

Artwork by @JennyBryan



Vectors of same length

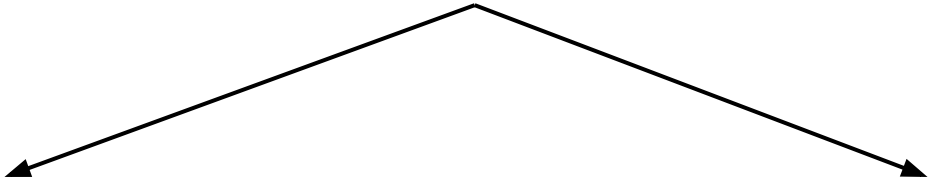
Dataframe

Artwork by @JennyBryan

How do we process

the data?

```
function(arg1, arg2, arg3, ...)
```



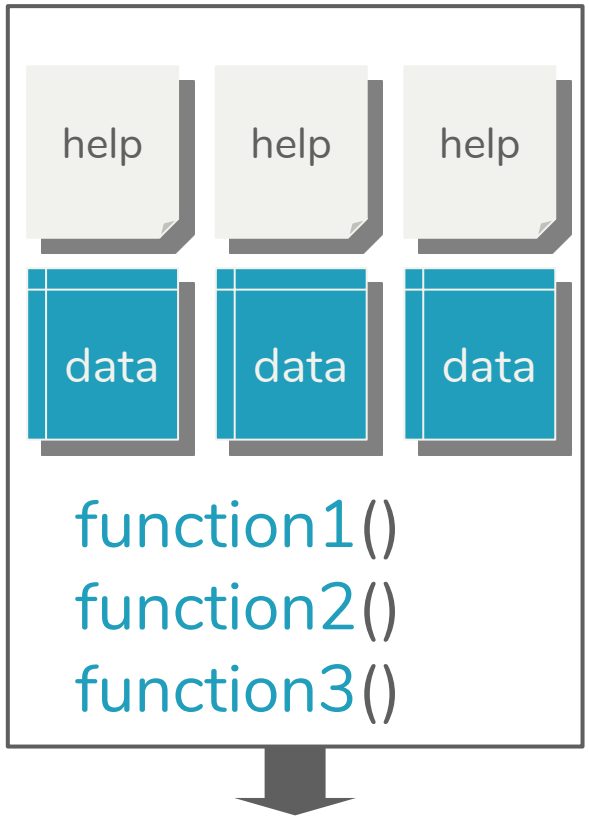
change_the_env(...)

calculate_value(...)

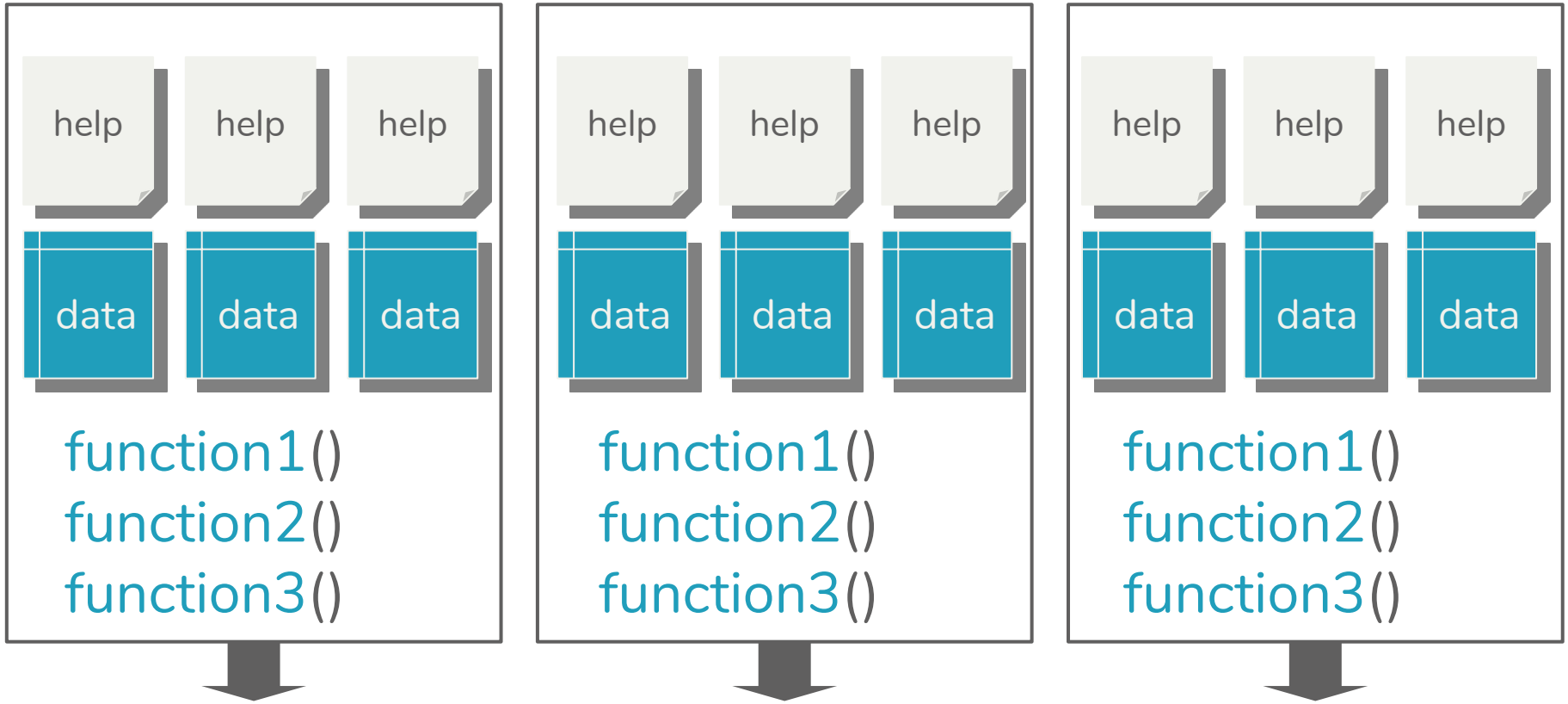
assign. <- , =, ->

- arguments are contexts of a function
- arguments are matched by name, or
- arguments are matched by position, **be careful!**

function1()
function2()
function3()



stats, graphics, grDevices, utils,
datasets, methods, base



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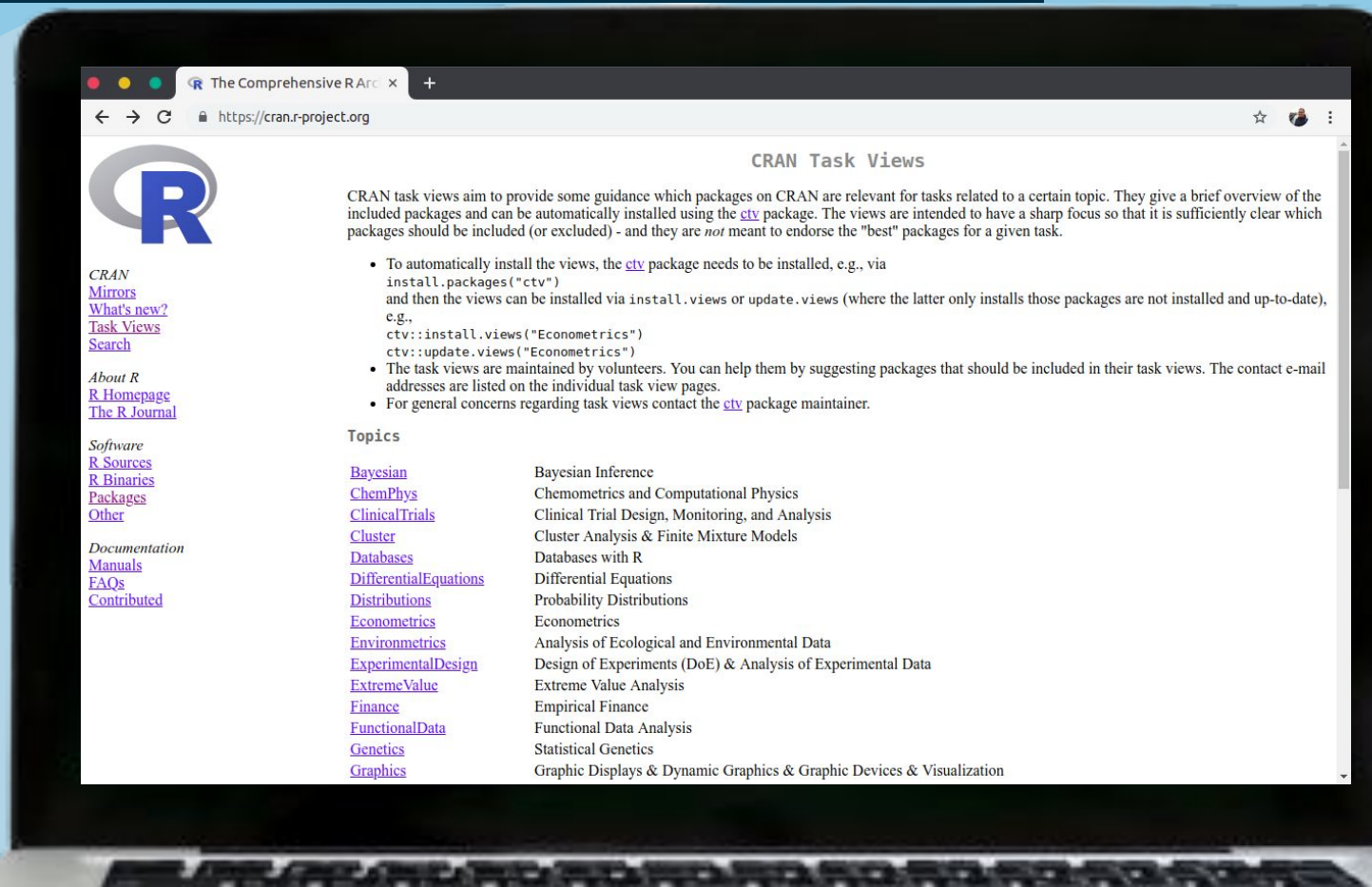
R packages

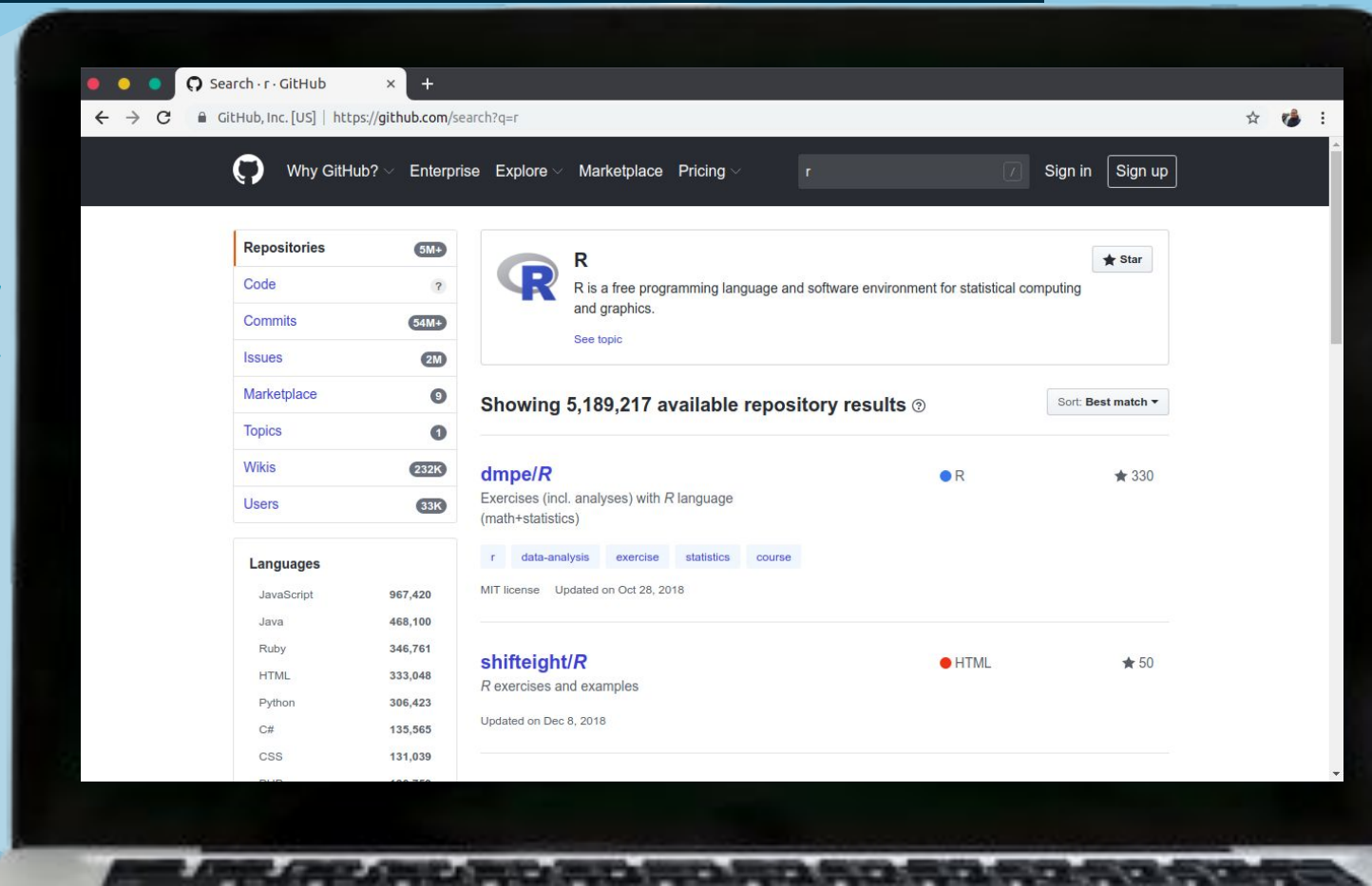
CRAN Task Views

https://cran.r-project.org/web/views/



GitHub

https://github.com/search?q=r



Installing package, only once

```
install.packages(“pkg”) # from CRAN/local
remotes::install_github(“user/pkg”) # from GitHub
remotes::install_bioc(“repo”) # from Bioconductor
```

Loading package, once in every session

```
library(pkg)
pacman::p_load(pkg) # load or install if not
available
```

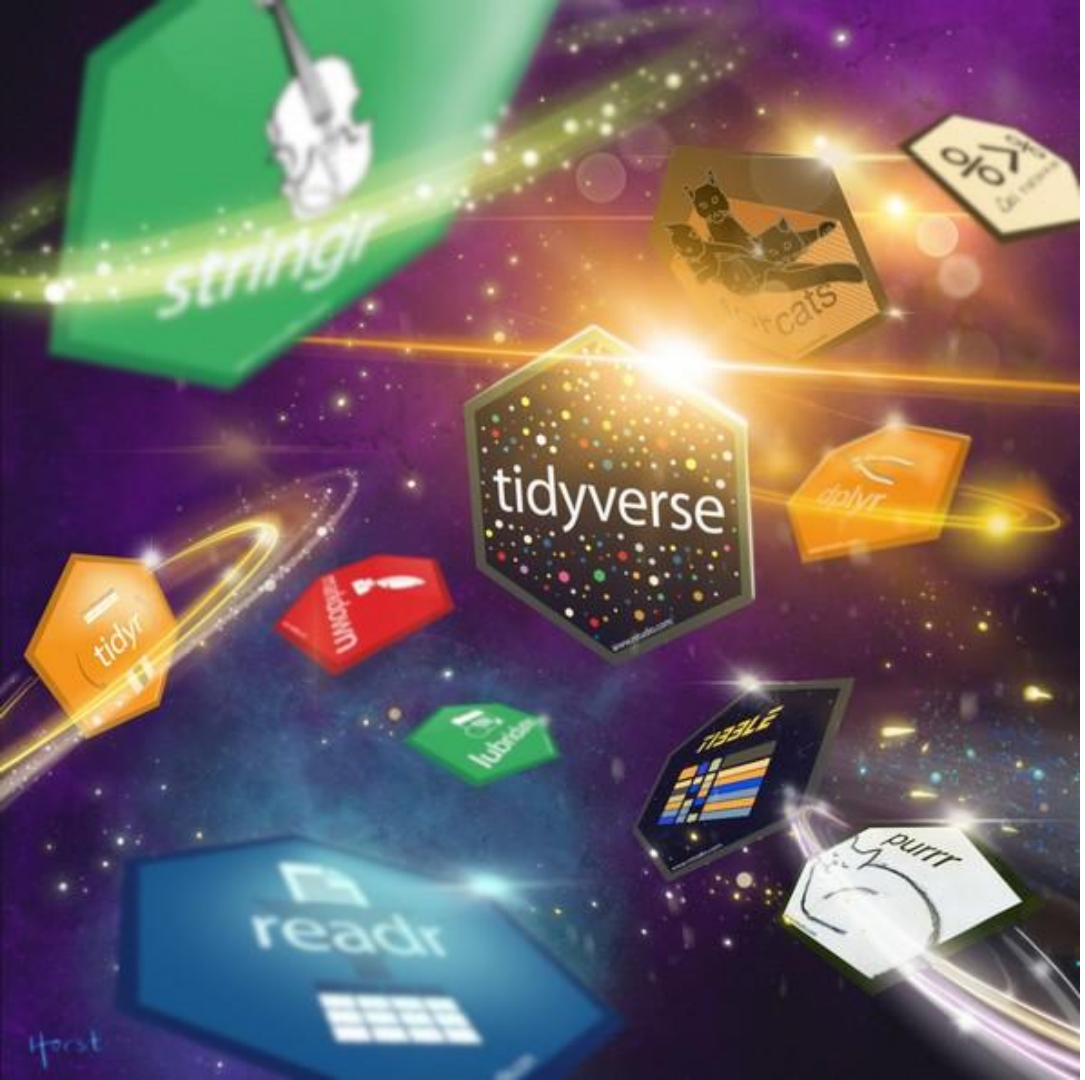
A lot of R packages

to use! :D

A lot of R packages

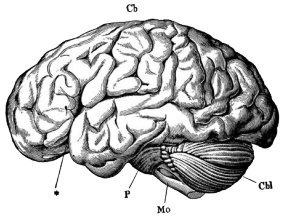
to use! :(


tidyverse
www.rstudio.com



The tidyverse is an opinionated **collection of R packages** designed for **data science**. All packages **share** an underlying **design** philosophy, **grammar**, and **data structures**.

Artwork by @allison_horst



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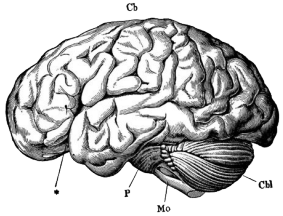

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Machine Language

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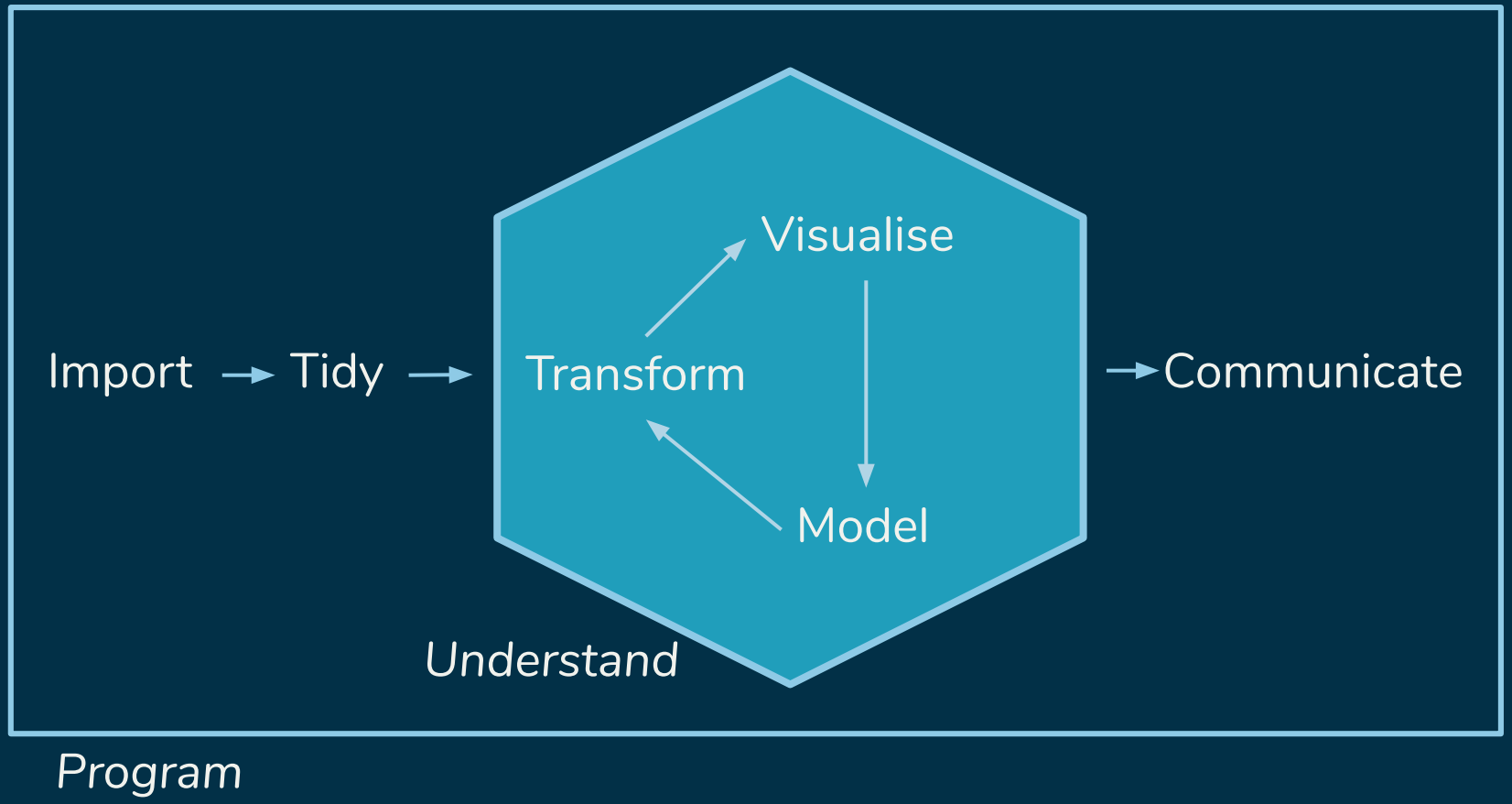
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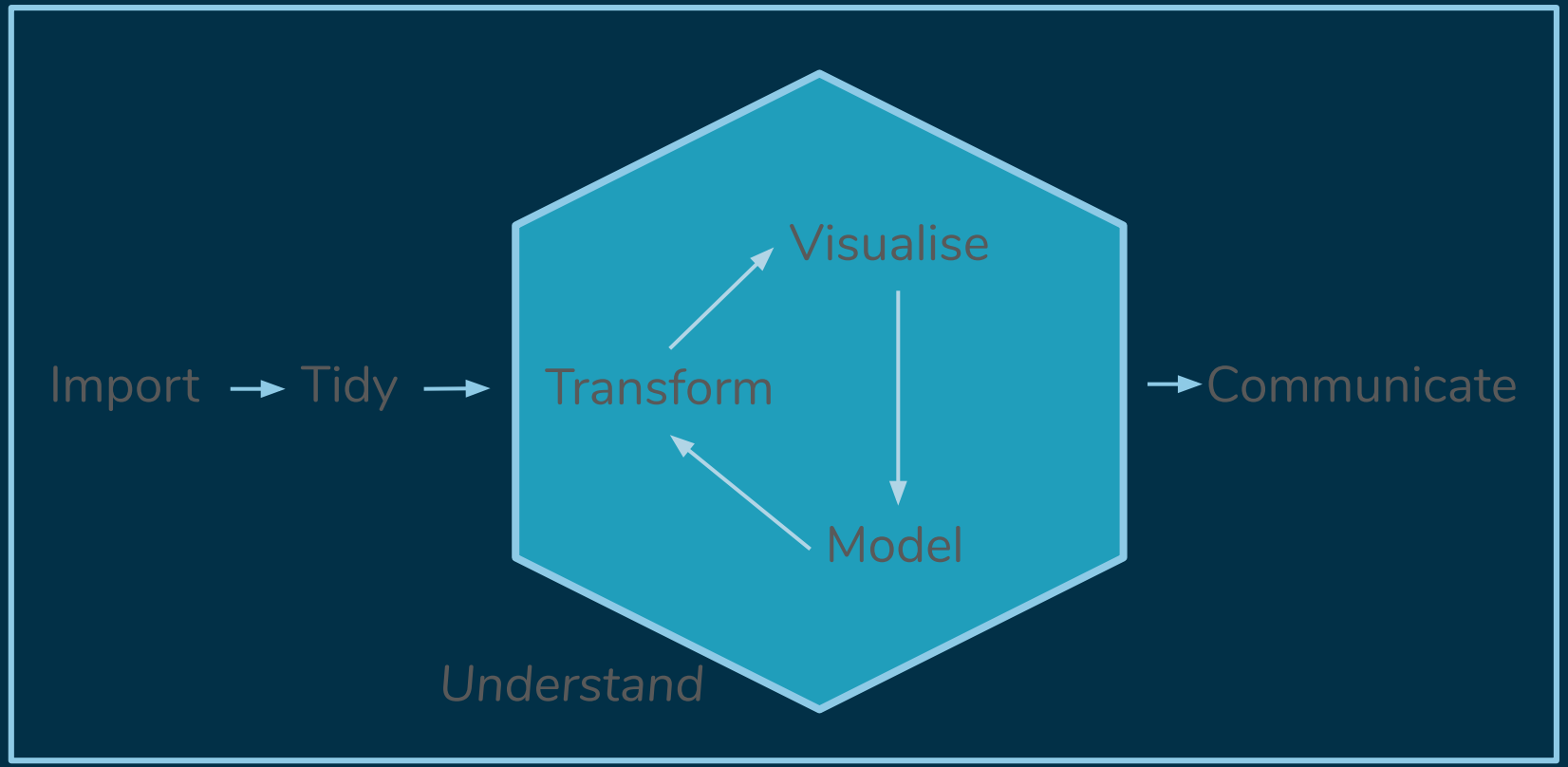
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tidyverse
www.rstudio.com

tidycode

tidymodels

tidync

tidyverts

tidycensus

tidygraph

tidytext

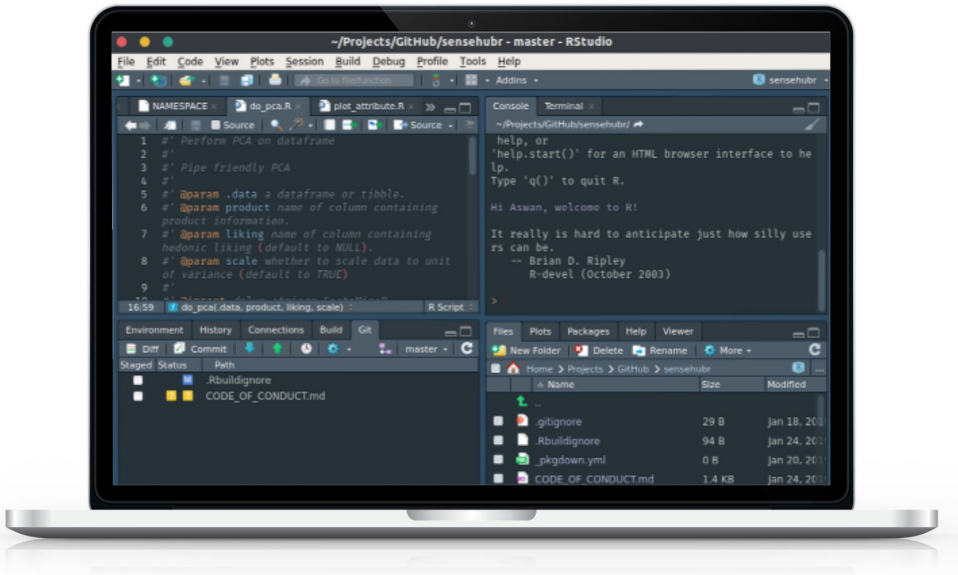
tidygenomics

Where to code?

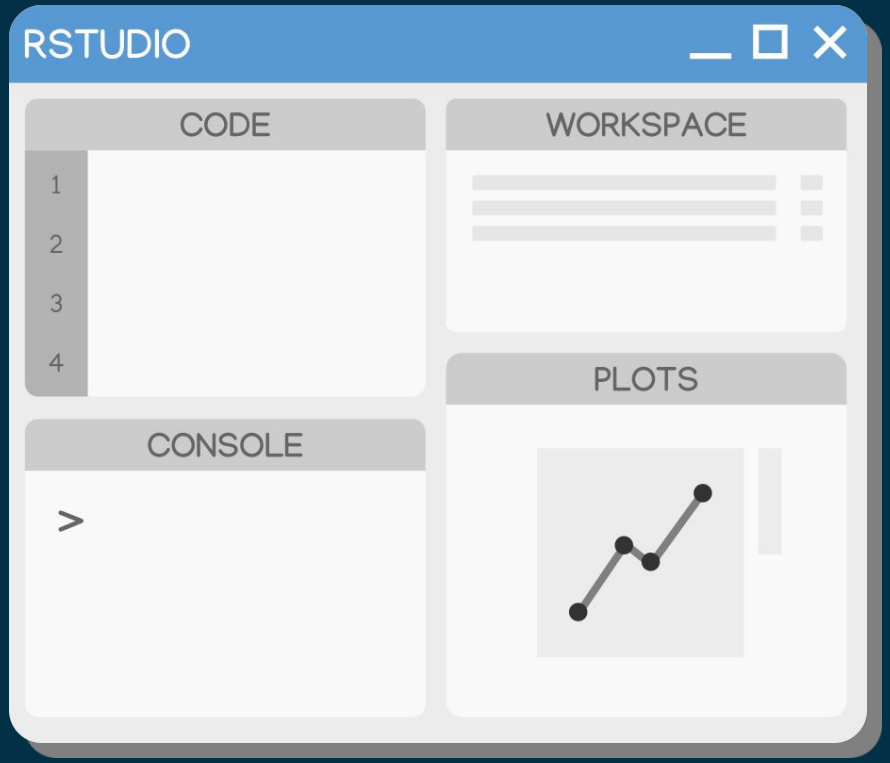
RStudio®

Main features:

- Console
- Syntax-highlighting editor
- Tools for plotting, history, debugging and workspace management



rstudio.com/products/rstudio/download/



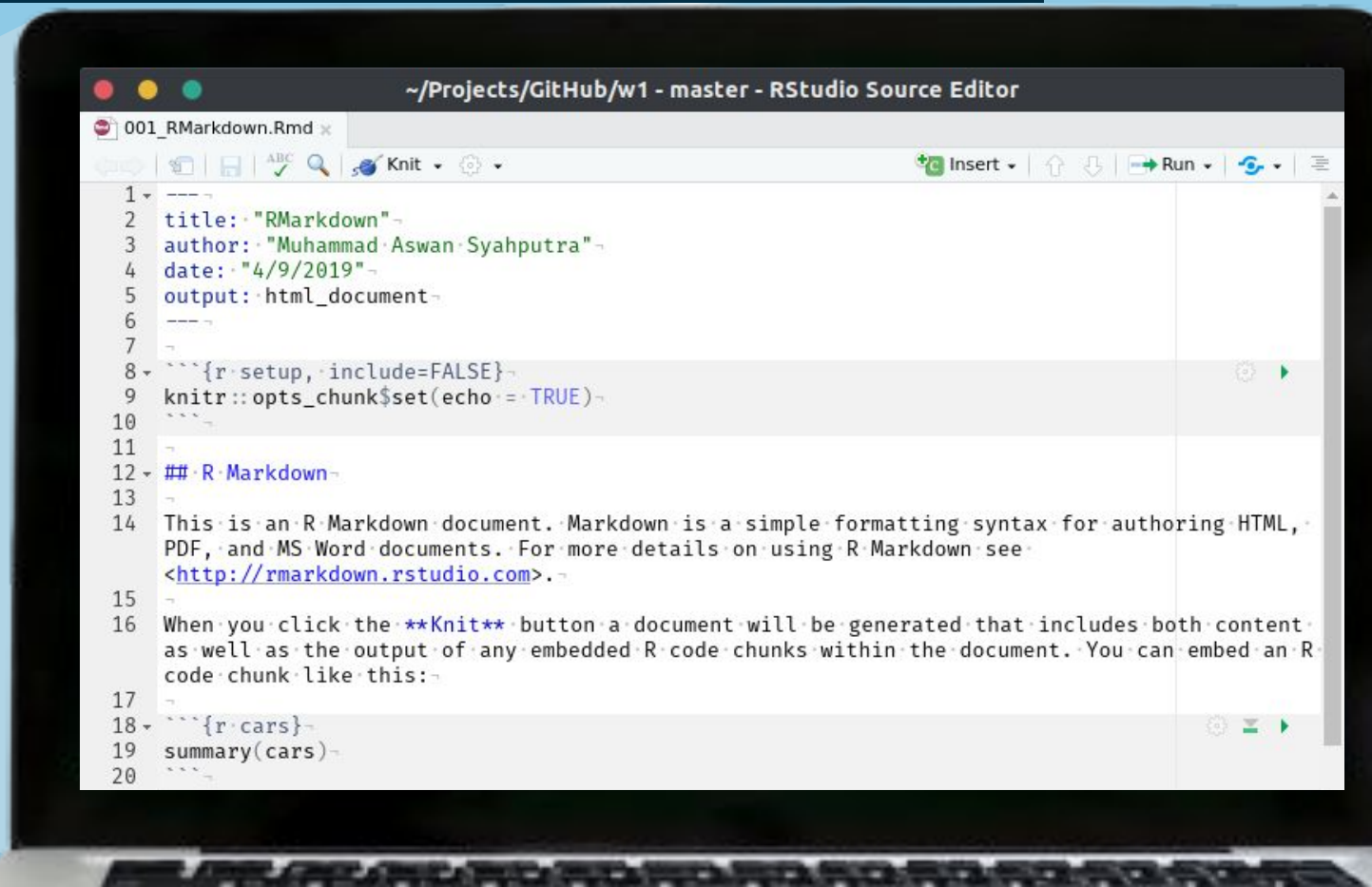
- **Tab**, autocompletion & path navigation
- **Alt + -**, for assignment operator <-
- **Ctrl + Shift + M**, for pipe operator %>%
- **Ctrl + Enter**, run current line code/example on help page
- **Ctrl + Up**, search for code history on console or editor pane
- **Alt + Up/Down**, move code to above or below
- **Alt + Shift + Up/Down**, copy code to above or below
- **Ctrl + D**, delete current line
- **Ctrl + Shift + F10**, restart R session
- **Ctrl + Alt + B**, run code up to current line

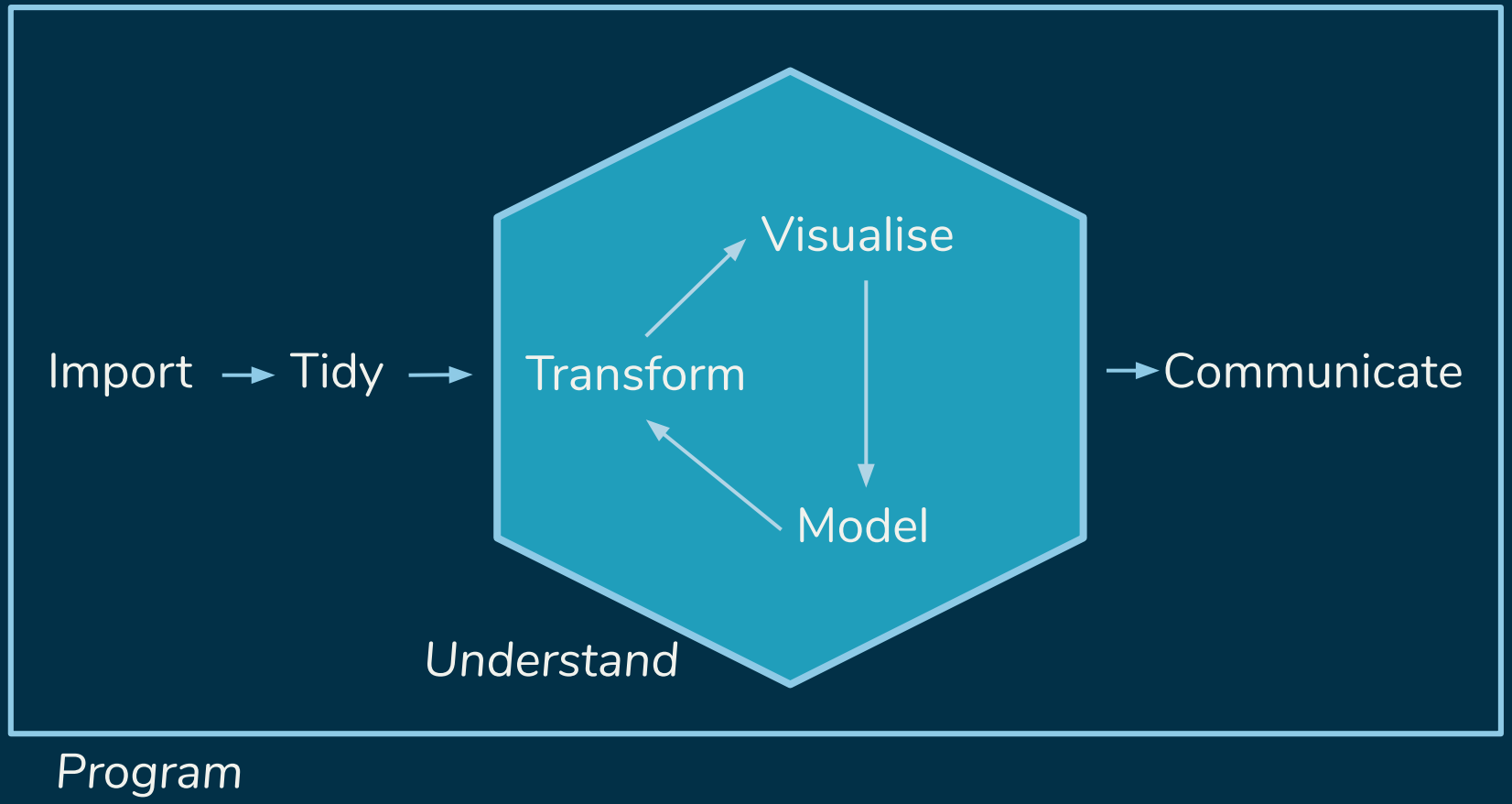
Cheatsheet: https://github.com/rstudio/cheatsheets/raw/master/rstudio-ide.pdf

Artwork by @allison_horst

R Markdown

A document format for authoring data science project

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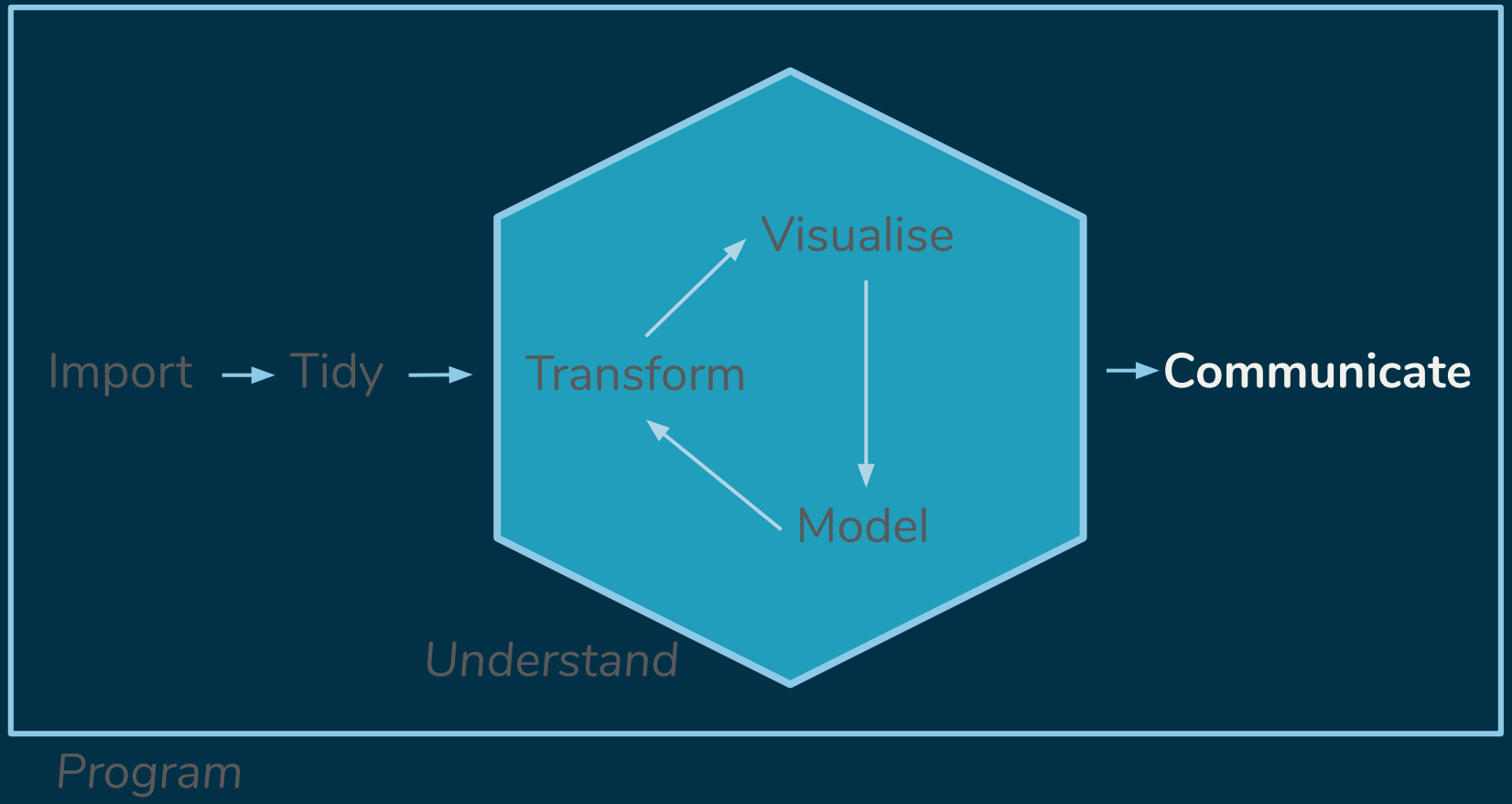
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- Use script (R Markdown or R Script), try to avoid console
- Use Projects, not setwd(...) in script
- Set stringsAsFactor = FALSE, but not in the .Rprofile
- Ctrl+Shift+F10 and Ctrl+Alt+B to clean up,
- not rm(list=ls())
- Learn the handy shortcuts
- Do not save and load .Rdata
- Use version control system: git!

Reading: happygitwithr.com

Download: git-scm.com

With great codes,
comes great bugs!

- (not) Uncle Ben

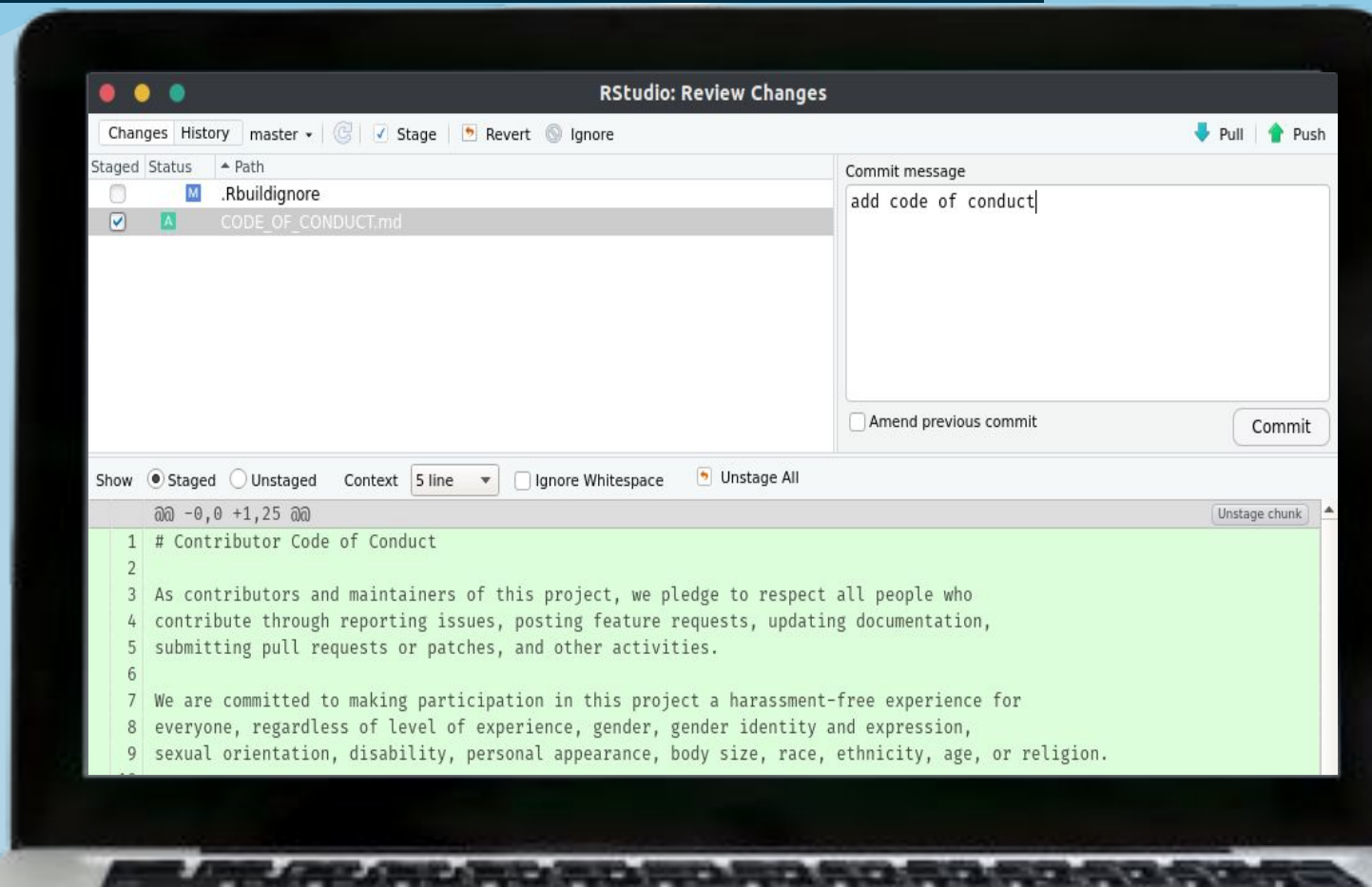
Store and share! Why sharing your work? Motivation here.

- git clone https://github/user/repo
- Do some works!
- git add file.R or git add .
- git commit -m “what you have done”
- git push origin master
- Repeat: work, git add, git commit, git push

git

- git init
- git remote add origin https://github/user/repo
- Do some works!
- git add file.R or git add .
- git commit -m “what you have done”
- git push -u origin master #use -u only once
- Repeat: work, git add, git commit, git push

It is available in RStudio!



Let's get them!

- Download R at **cran.r-project.org**
- Download RStudio at **rstudio.com**
- Download git **git-scm.com**

How to **set**?

- Create account at **github.com**
- In Rstudio, Tools – Global Options – Git/SVN – Browse git executable:
  - Windows:
  - **C:/Program Files/Git/bin/git.exe**
  - UNIX/UNIX-like:
  - **/usr/bin/git**

How to set?

- Open git bash/shell/terminal
- Run:

```
git config --global user.email
“email@domain.com”
```

```
git config --global user.name
“Your Name”
```

Let's get **started**!

- Go to **github.com/r-academy/tidyds**
- Hit 'Fork' button
- Click 'Clone or Download', copy the URL
- In RStudio, File – New Project – Version Control – Git. Paste URL
- In File pane (bottom-right), click vignettes-'m1_essentials.Rmd' to open it

Working directory

```
> fs::dir_tree()
.
├── 003_kamisdata_Debat-Pilpres1-2019.Rproj
├── Dockerfile
├── R
│   ├── cari.R
│   └── impor.R
├── README.md
├── data
│   └── debat-pilpres1-2019.rda
├── data-raw
│   └── debat_pilpres1_2019.R
├── install.R
└── vignettes
    ├── aswansyahputra-frekuensidansentimen.Rmd
    ├── aswansyahputra-frekuensidansentimen.html
    └── aswansyahputra-frekuensidansentimen_files
> 
```

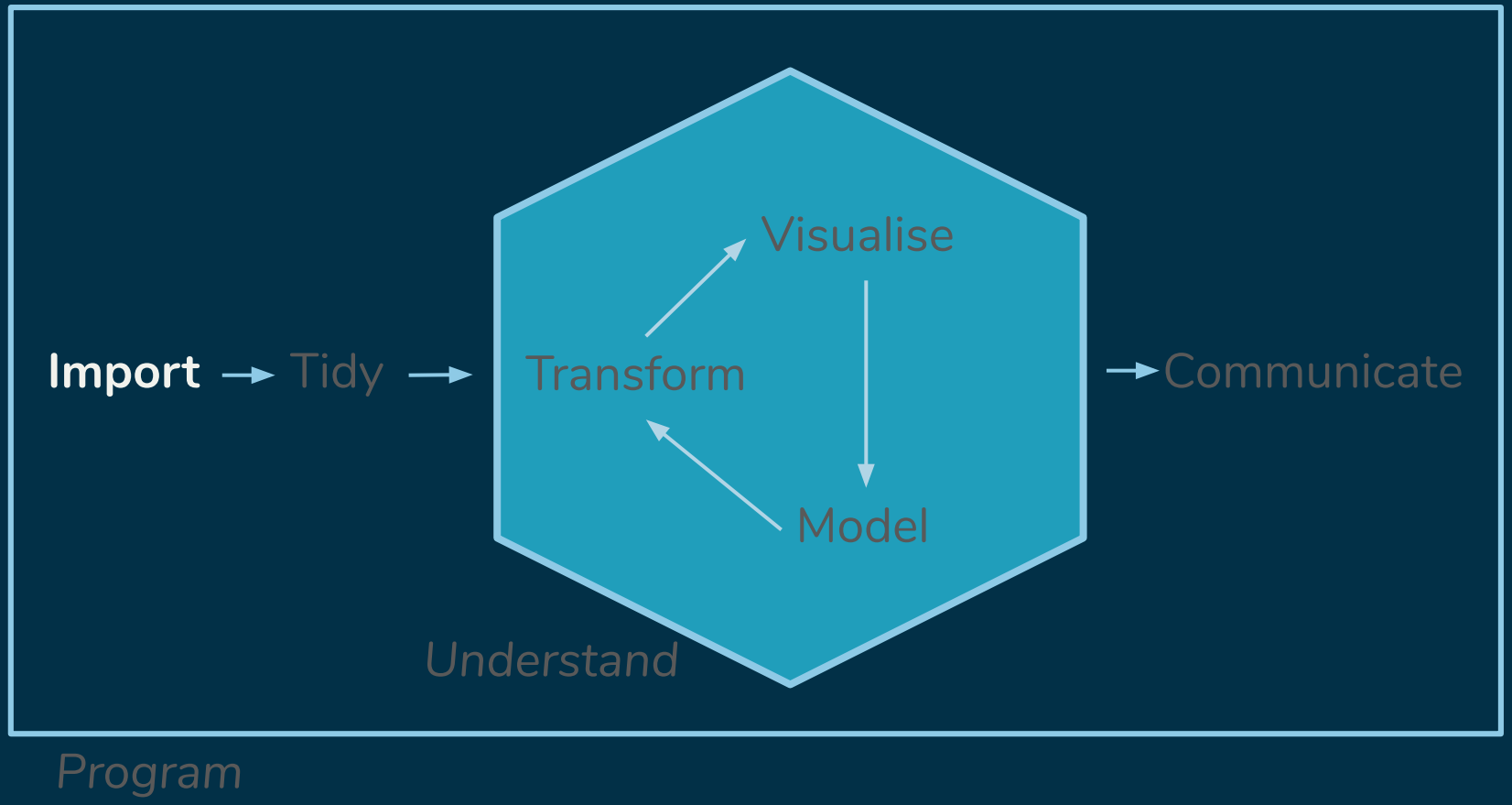
3 principles for naming files:

- Machine readable
- Human readable
- Default ordering

More info:
speakerdeck.com/jennybc/how-to-name-files

How to use **git**?

- In Environment Pane, hit ‘Git’ tab
- Click commit, a window pane will appear
- Select all files (Ctrl + A), click ‘Stage’
- Fill commit message, the click ‘Commit’
- Hit ‘Push’ Button, done!
- You may check you GitHub now!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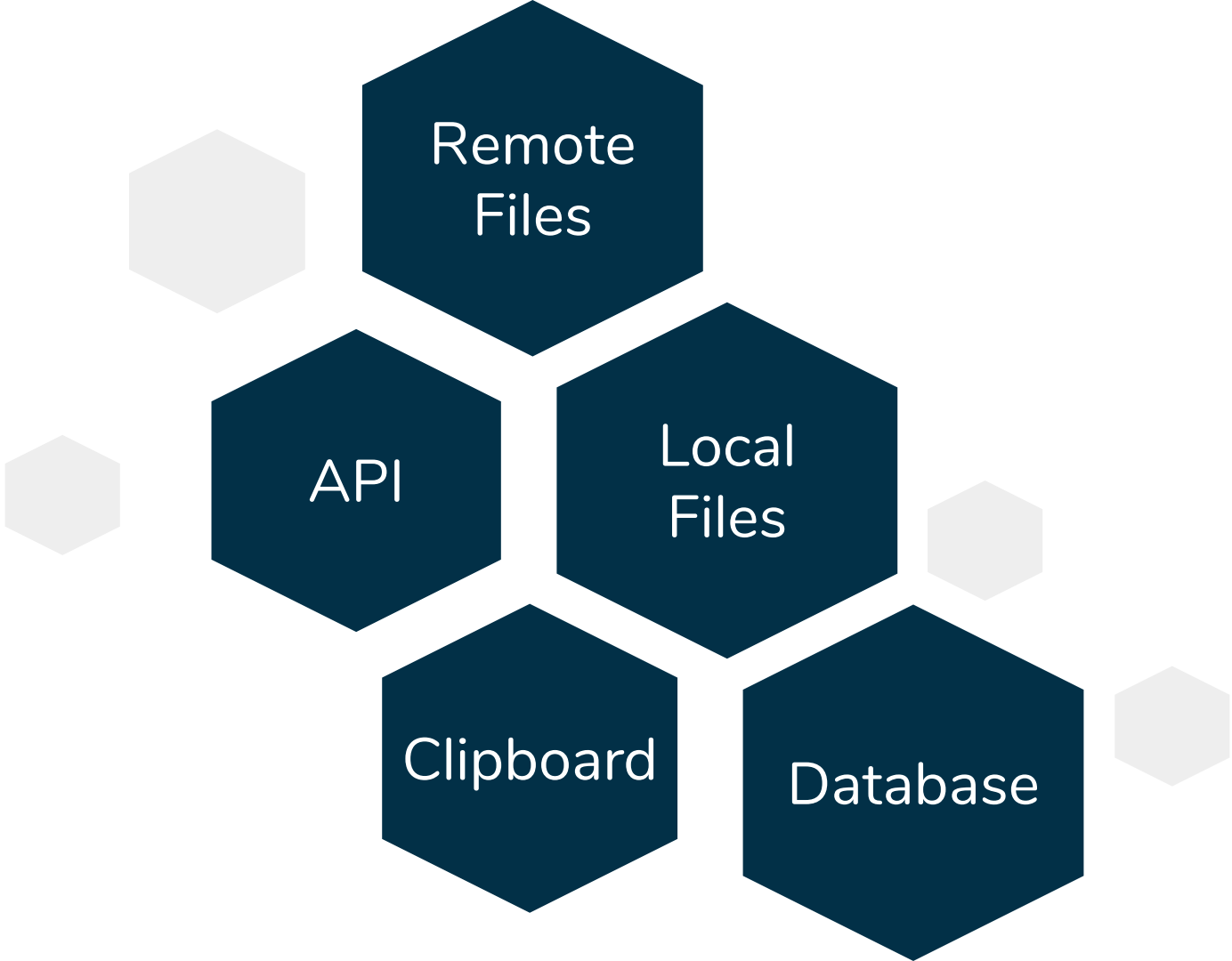
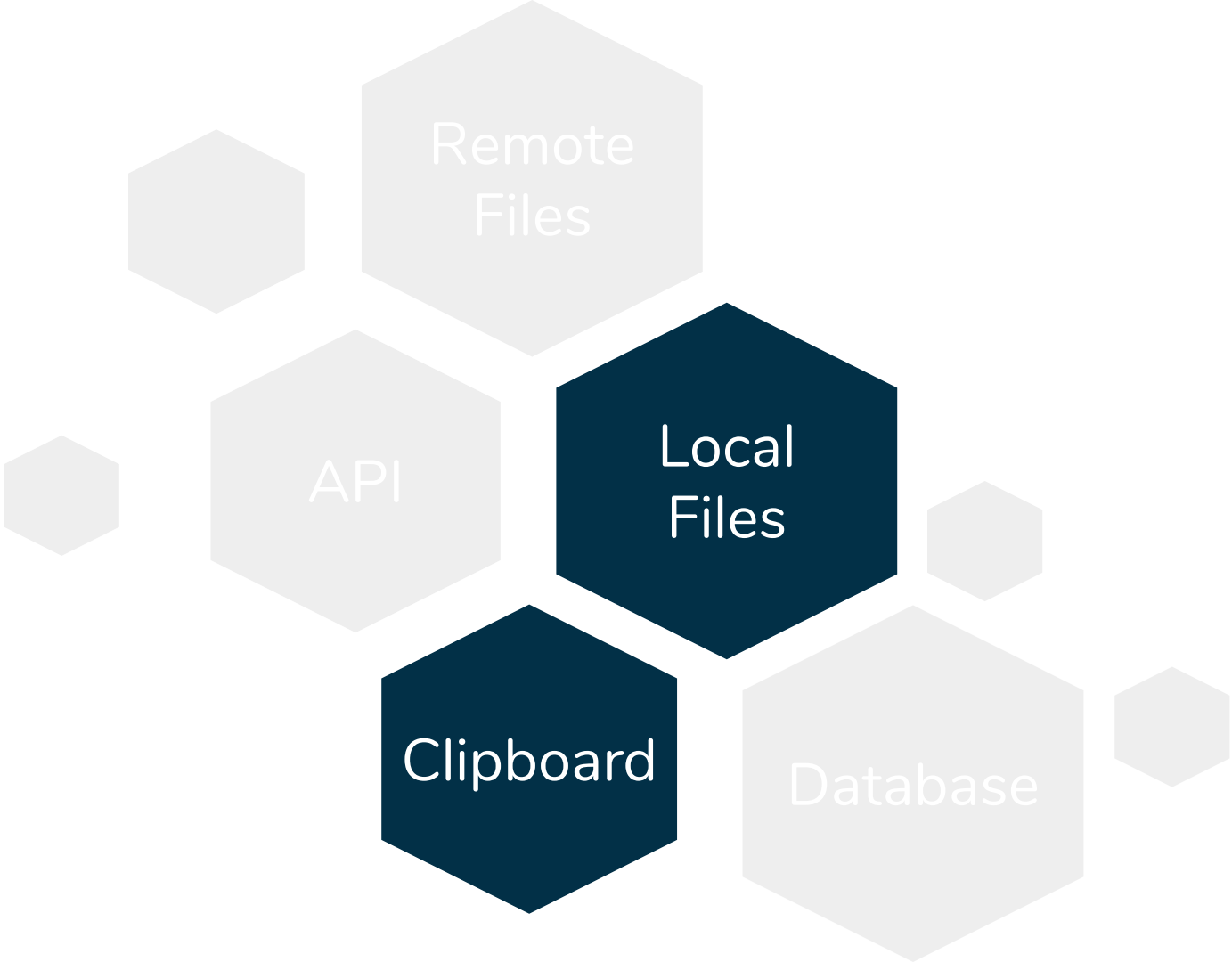

Remote Files
API
Local Files
Clipboard
Database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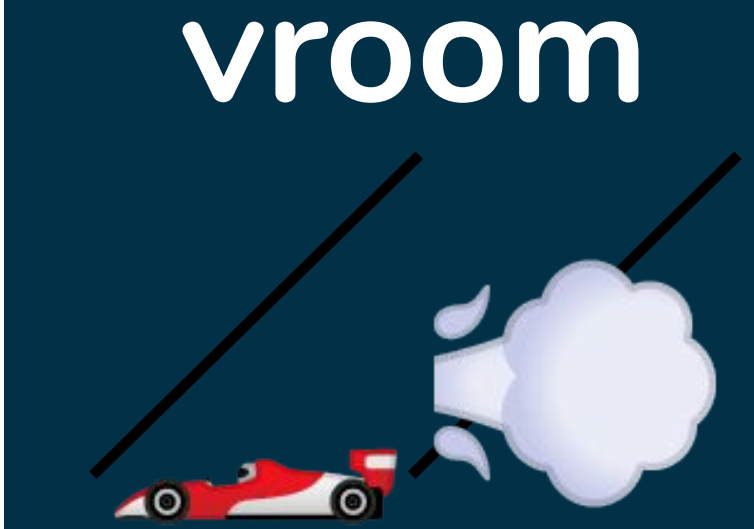
- vroom(): comma separated (CSV) files
- vroom(): tab separated files
- vroom(): general delimited files
- vroom(): fixed width files
- vroom(): tabular files where columns are separated by white-space.



Tame data is lovely

- Use syntactical names for column names
- Use consistent case: snake_case, camelCase, caterpillar.case
- Cast column type accordingly: <chr>, <dbl>, <lgl>, <date>, etc
- Treat <fct> carefully!
- Preferably turn implicit missing observation into explicit NA value

```
x <- something
for (i in seq_along(x) {
  function(x[[i]])
}
```

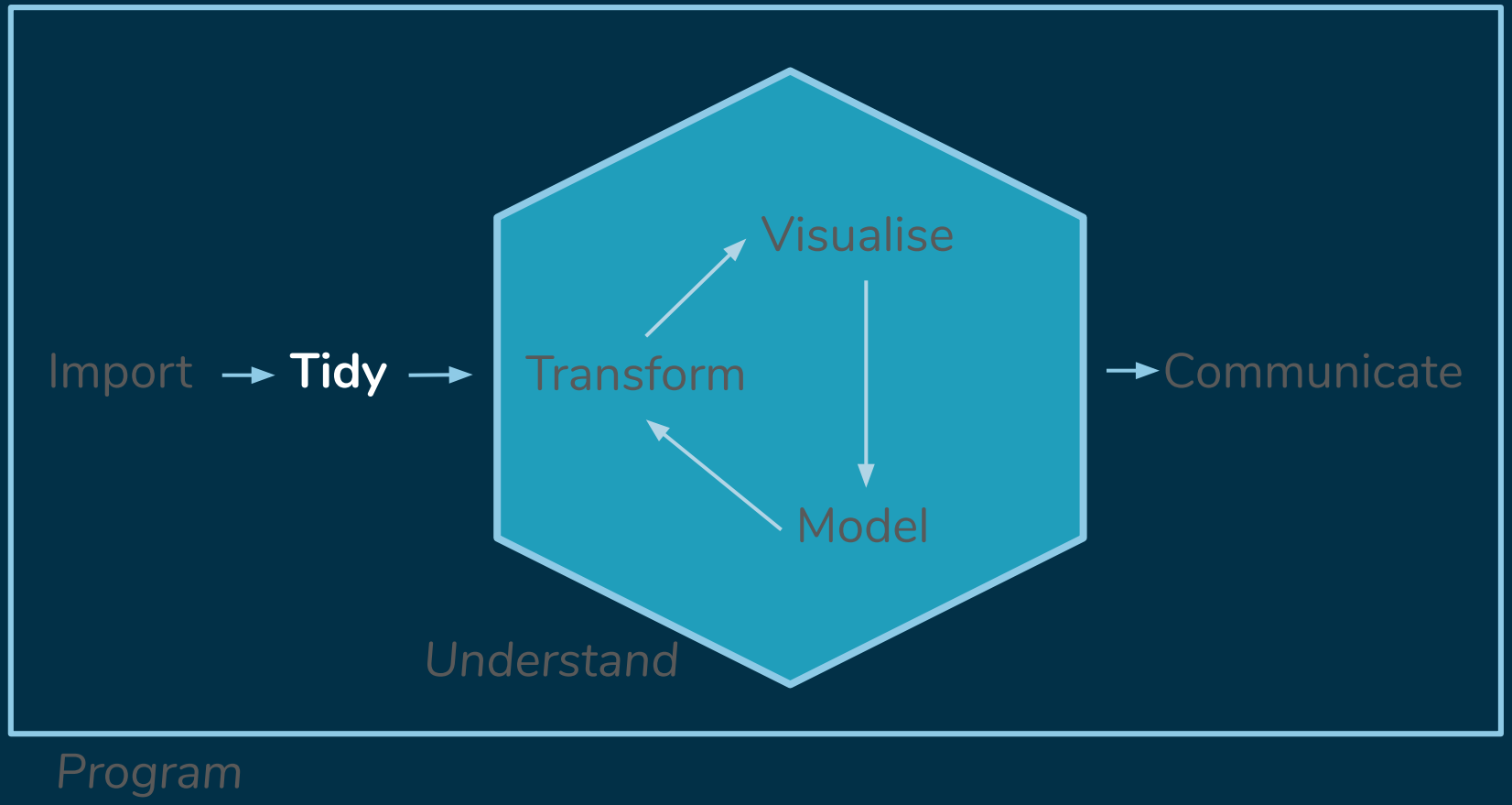
```
x <- something
*apply(x, function)
```

```
x <- something
map_*(x, function)
```

purrr

Let's do **practice**!

- Open 'm2_data-import.Rmd'
- Do not forget to push your works into GitHub!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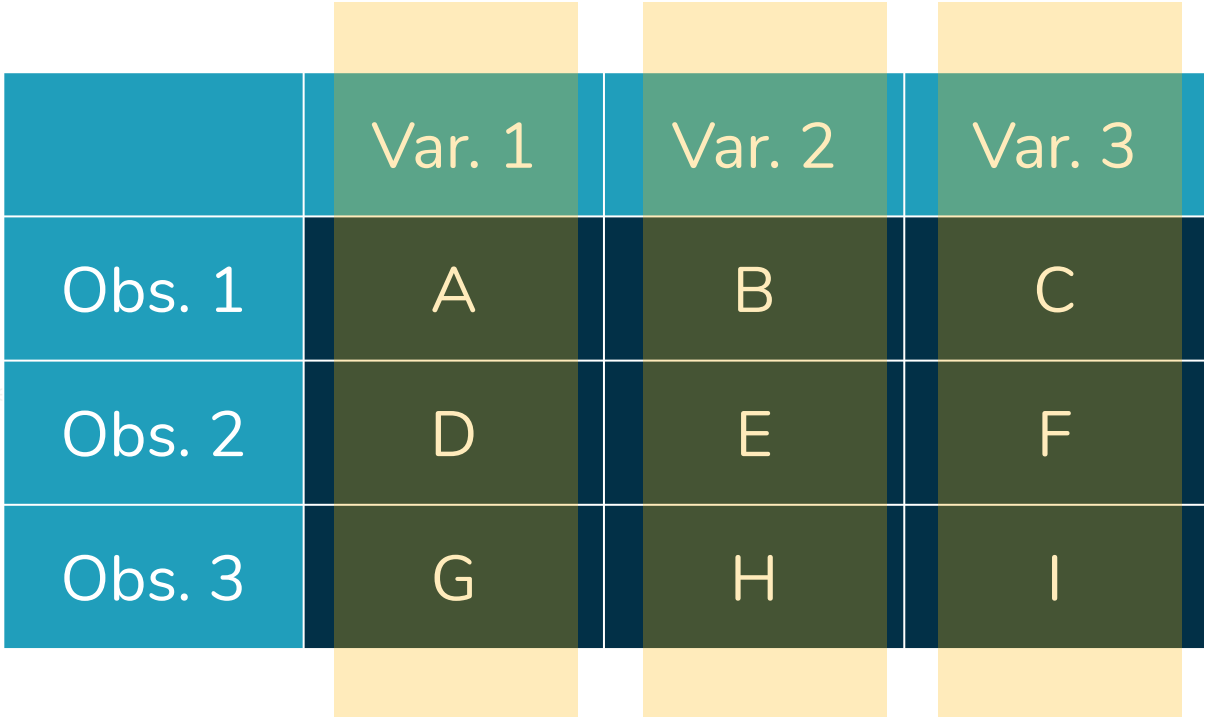
Tidy datasets are all alike,
but every messy dataset is
messy in its own way!

- *Hadley Wickham*

A Tidy dataset

	Name	Gender	Age
1	Jane	Male	44
2	Lisbon	Female	38
3	John	Male	NA

A variable has its own column



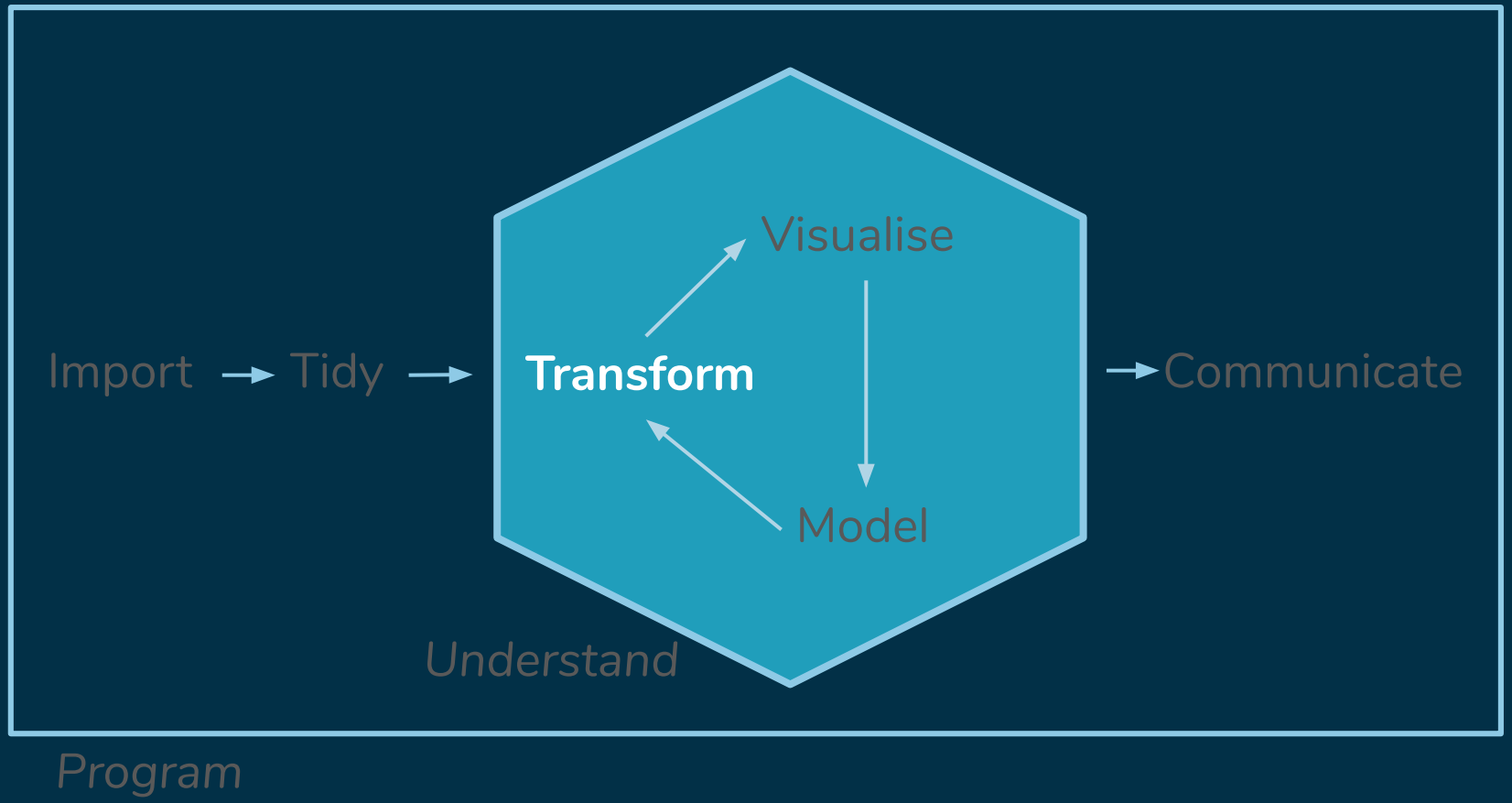
An observation has its own row

	Var. 1	Var. 2	Var. 3
Obs. 1	A	B	C
Obs. 2	D	E	F
Obs. 3	G	H	I

A value has its own cell

	Var. 1	Var. 2	Var. 3
Obs. 1	A	B	C
Obs. 2	D	E	F
Obs. 3	G	H	I

Artwork by @allison_horst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Artwork by @allison_horst

dplyr basic functions:

- filter() selects rows based on their values
- mutate() creates new variables
- select() picks columns by name
- summarise() calculates summary statistics
- arrange() sorts the rows

tidyr basic functions:

- gather() wide-format >> long-format
- spread() long-format >> wide-format
- fill() fills value based on previous entry
- complete() turns implicit missing values into explicit

Operators:

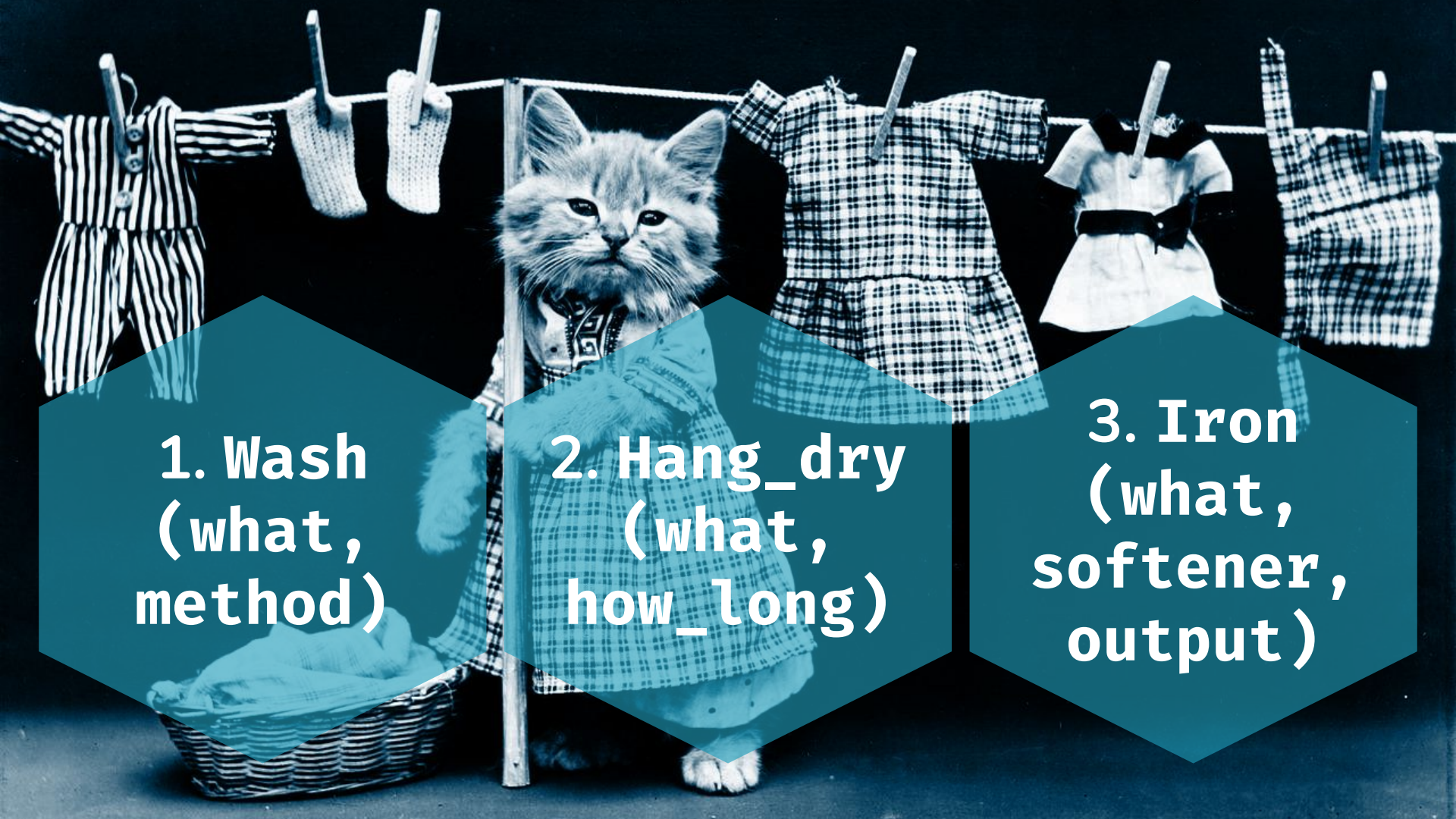
- ! (not)
- | (or)
- & (and)
- ==, !=
- <, <=, >, >=
- %in%
- is.na()

Credits to Michael Toth

How can I

chain?


1. Wash
2. Hang_dry
3. Iron


1. Wash (what, method)
2. Hang_dry (what, how_long)
3. Iron (what, softener, output)


```
> washed_clothes ← wash(what = dirty_clothes,
                        method = “handwash”)
> dry_clothes ← hang_dry(what =
                         washed_clothes,
                         how_long = 8)
> iron(what = dry_clothes, softener = TRUE,
       output = “neat.clothes”)
```


```
> washed_clothes ← wash(what = dirty_clothes,
                        method = “handwash”)
> dry_clothes ← hang_dry(what =
                         washed_clothes,
                         how_long = 8)
> iron(what = dry_clothes, softener = TRUE,
       output = “neat.clothes”)
```


```
> iron(
      hang_dry(
            wash(what = dirty_clothes, method =
                  “handwash”),
            how_long = 8),
      softener = TRUE,
      output = “neat.clothes”)
```

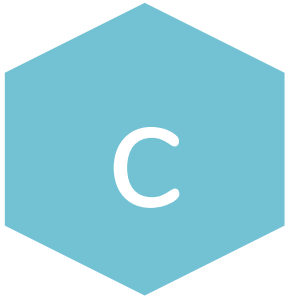
```
function(arg1, arg2, arg3, ...)
```

```
arg1 %>%
  function(arg2, arg3, ...)
```

```
function(arg1, arg2, arg3, ...)
```

```
arg2 %>%
  function(arg1, arg2=., arg3,
           ...)
```

magrittr




```
> wash(what = dirty_clothes,
       method = “handwash”) %>%
     hang_dry(how_long = 8) %>%
          iron(softener = TRUE,
               output = “neat.clothes”)
```

R Syntax Comparison

Dollar sign

goal(data$x, data$y)

- A.k.a base syntax
- Subsetting data by using '[ ]'

Formula

goal(y~x, data=data)

Mostly used in modeling and statistical test

Tidyverse

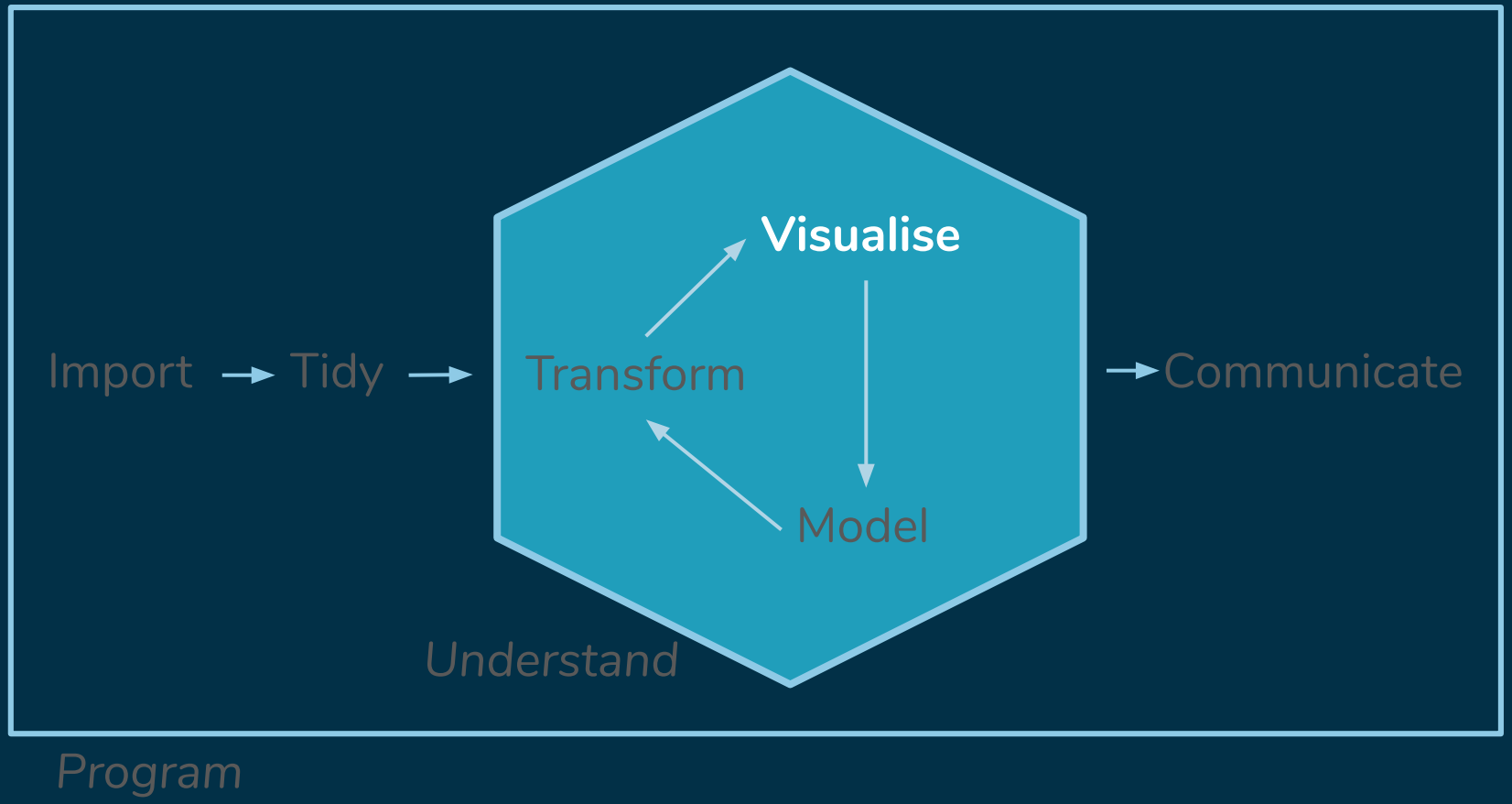
data %>% goal(x, y)

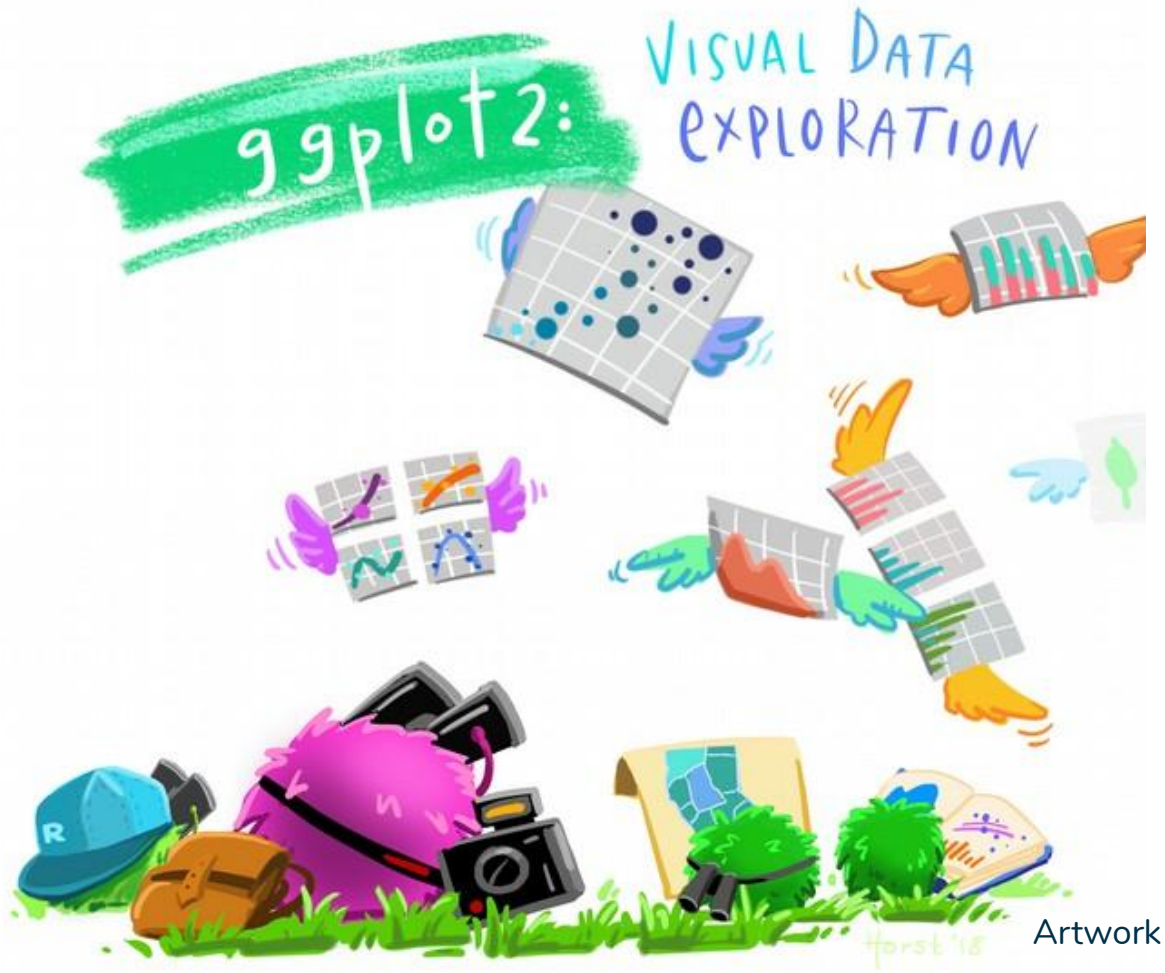
- Expecting data as the first argument
- Plotting using '+' flavour

Cheatsheet: https://github.com/rstudio/cheatsheets/raw/master/syntax.pdf

Let's do **practice**!

- Open 'm3_tidy-data-carpentry.Rmd'
- Do not forget to push your works into GitHub!


Visualise
Import
Tidy
Transform
Communicate
Model
Understand
Program

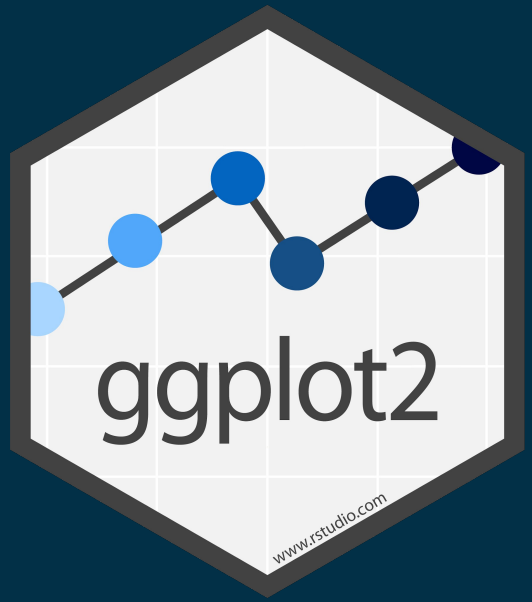


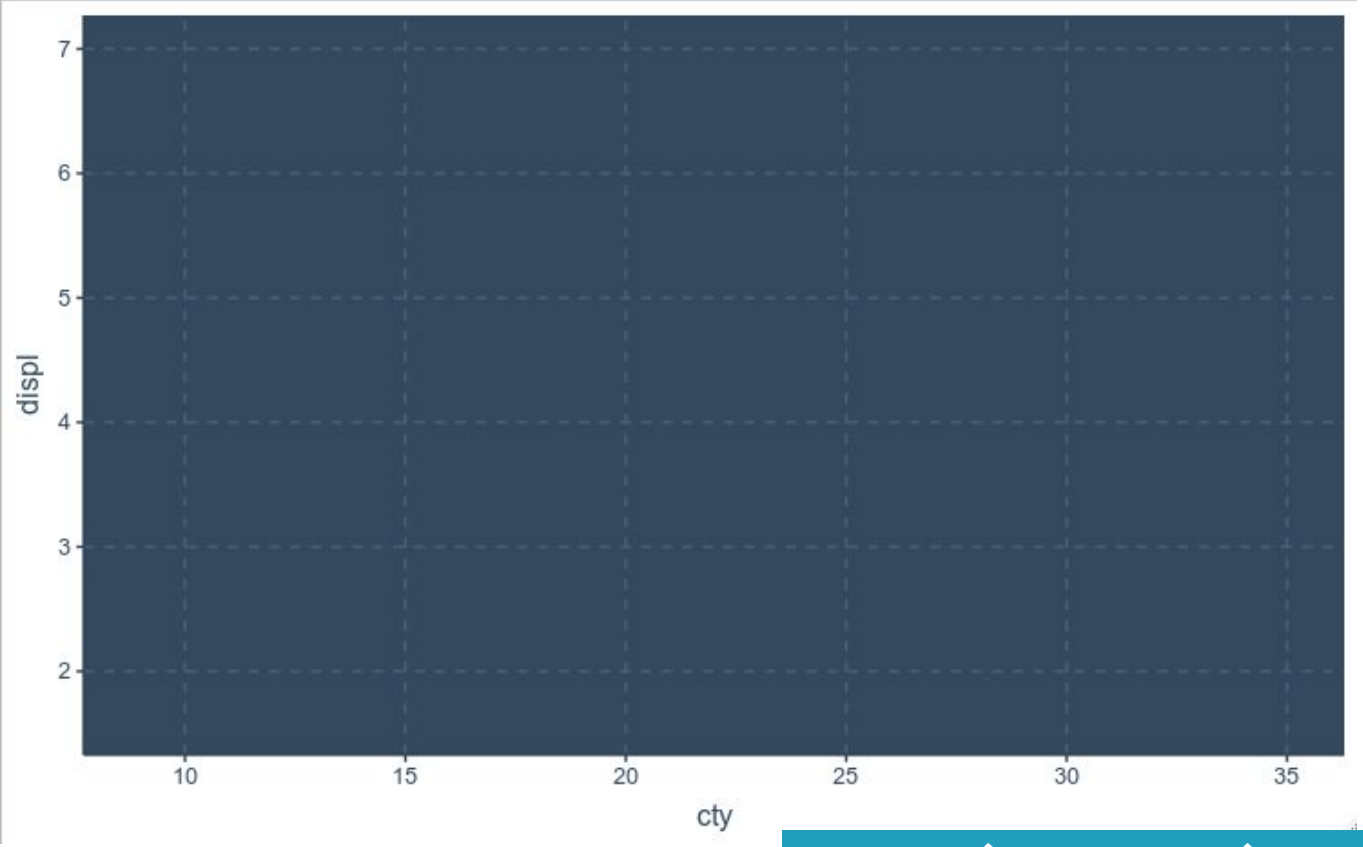
Artwork by @allison_horst

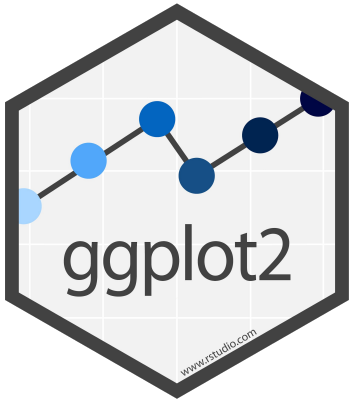
```
ggplot(data) +
    geom_X(mapping=aes(…)) +
    ...

ggplot(data, mapping=aes(...)) +
    geom_X() +
    ...
```

```
data %>%
    ggplot(mapping=aes(...)) +
    geom_X() +
    ...
```

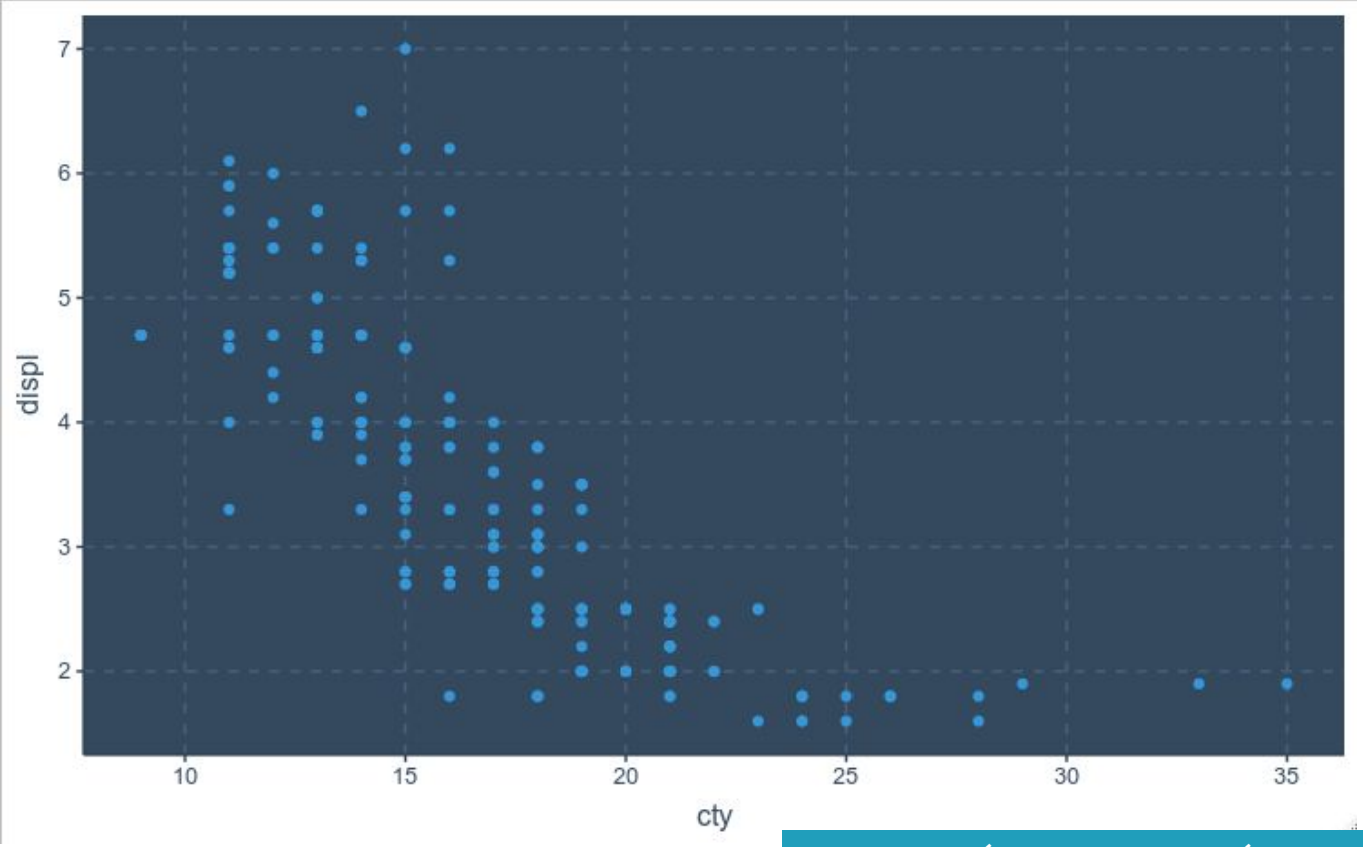
ggplot2

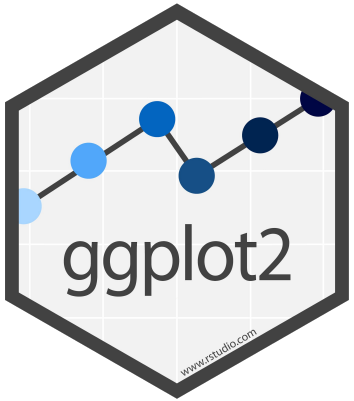




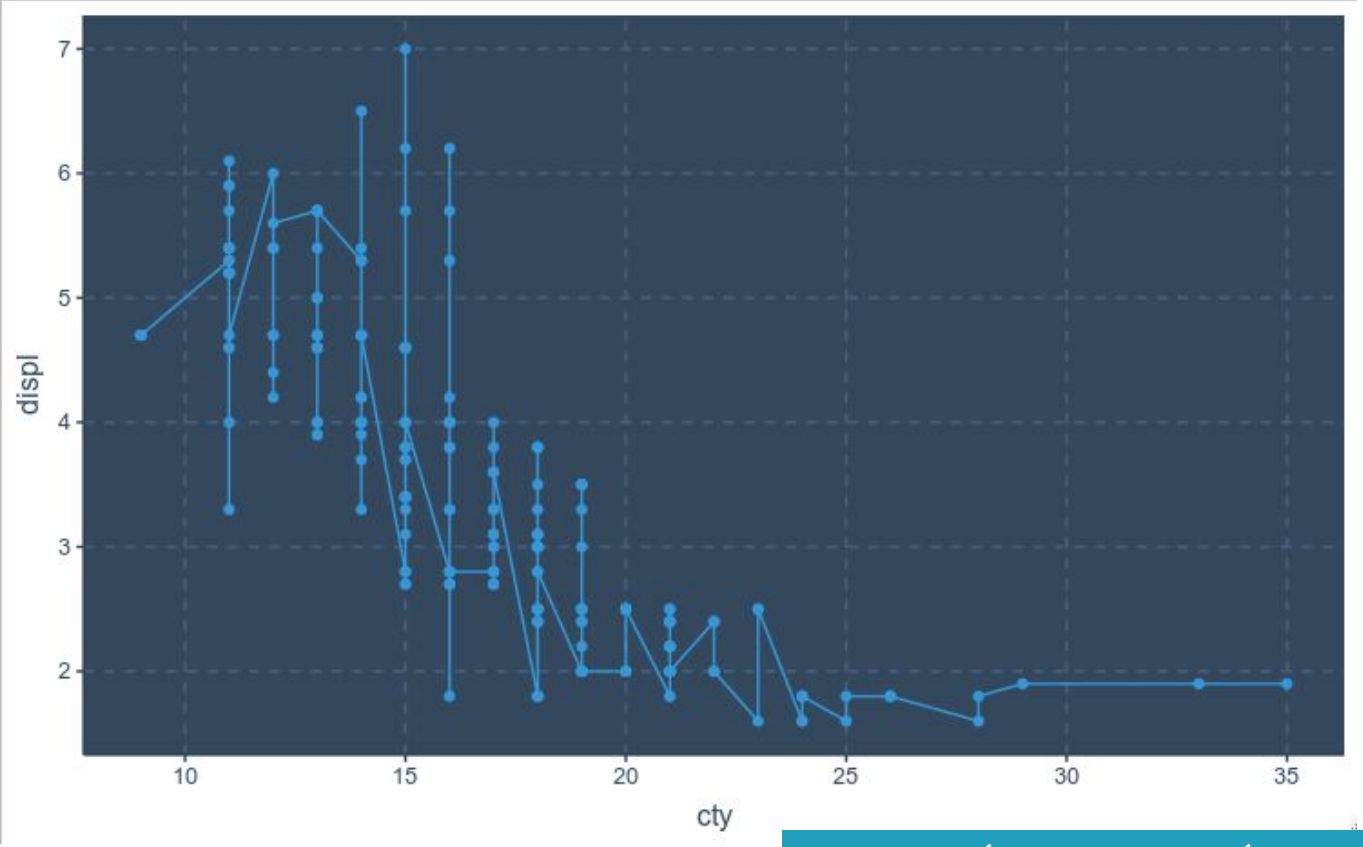


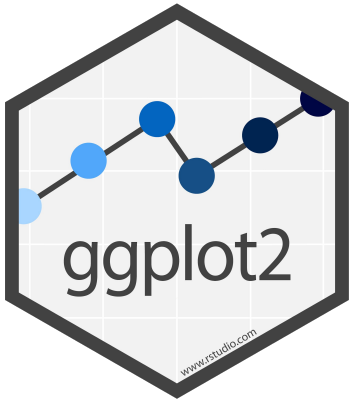

```
ggplot(mpg, aes(x = cty, y = displ))
```



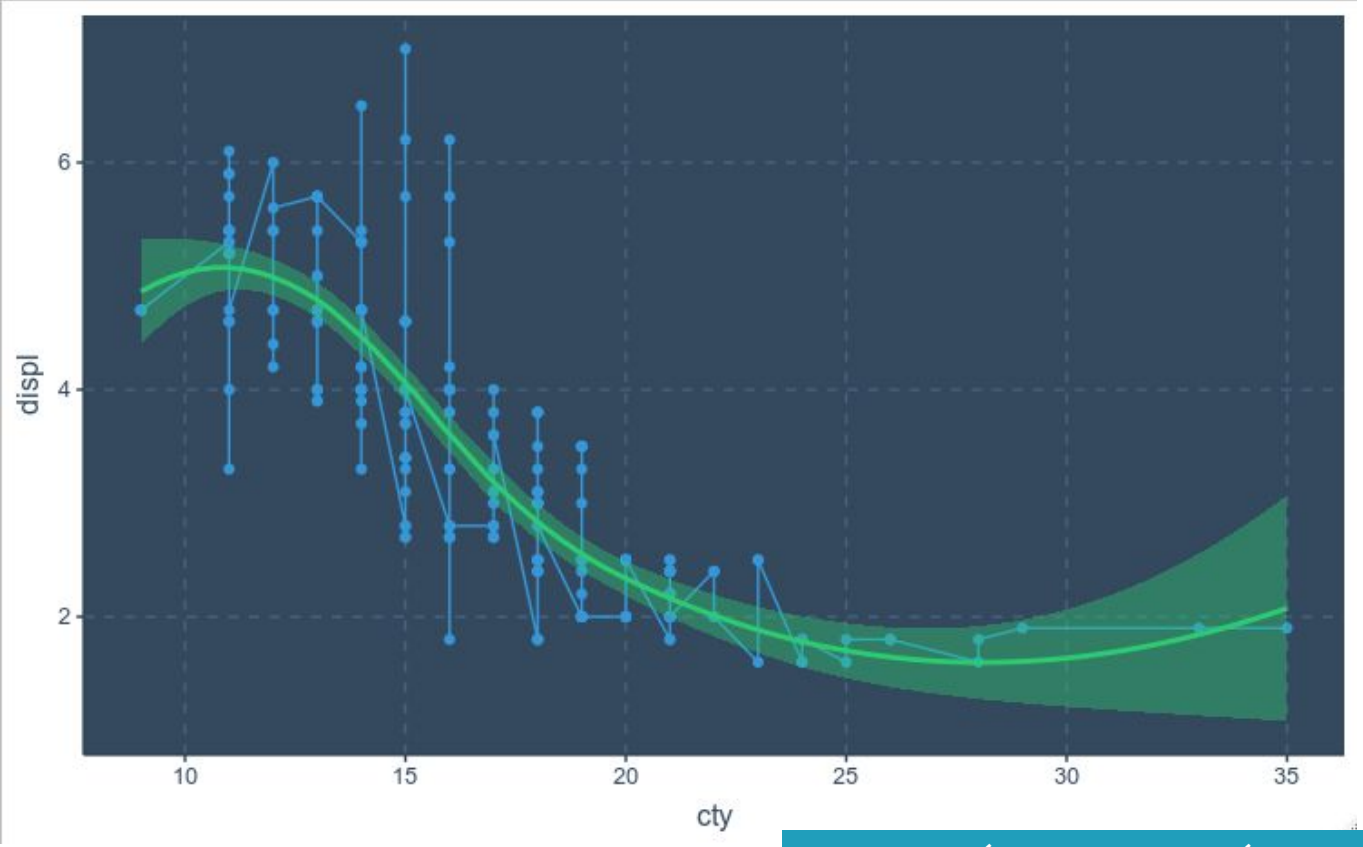


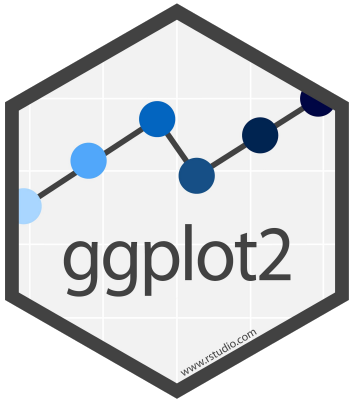

```
ggplot(mpg, aes(x = cty, y = displ)) +
  geom_point()
```






```
ggplot(mpg, aes(x = cty, y = displ)) +
  geom_point() +
  geom_line()
```

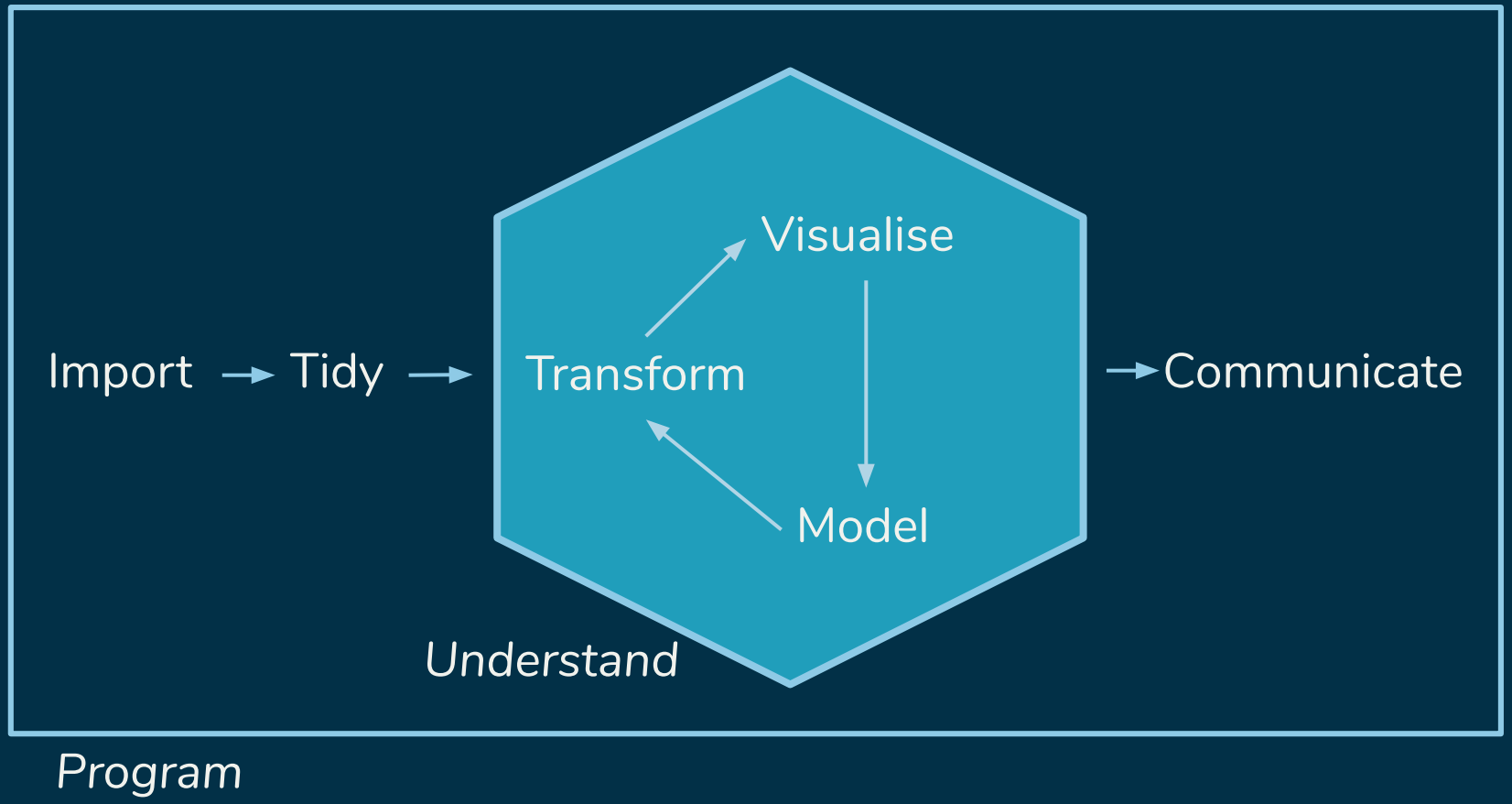


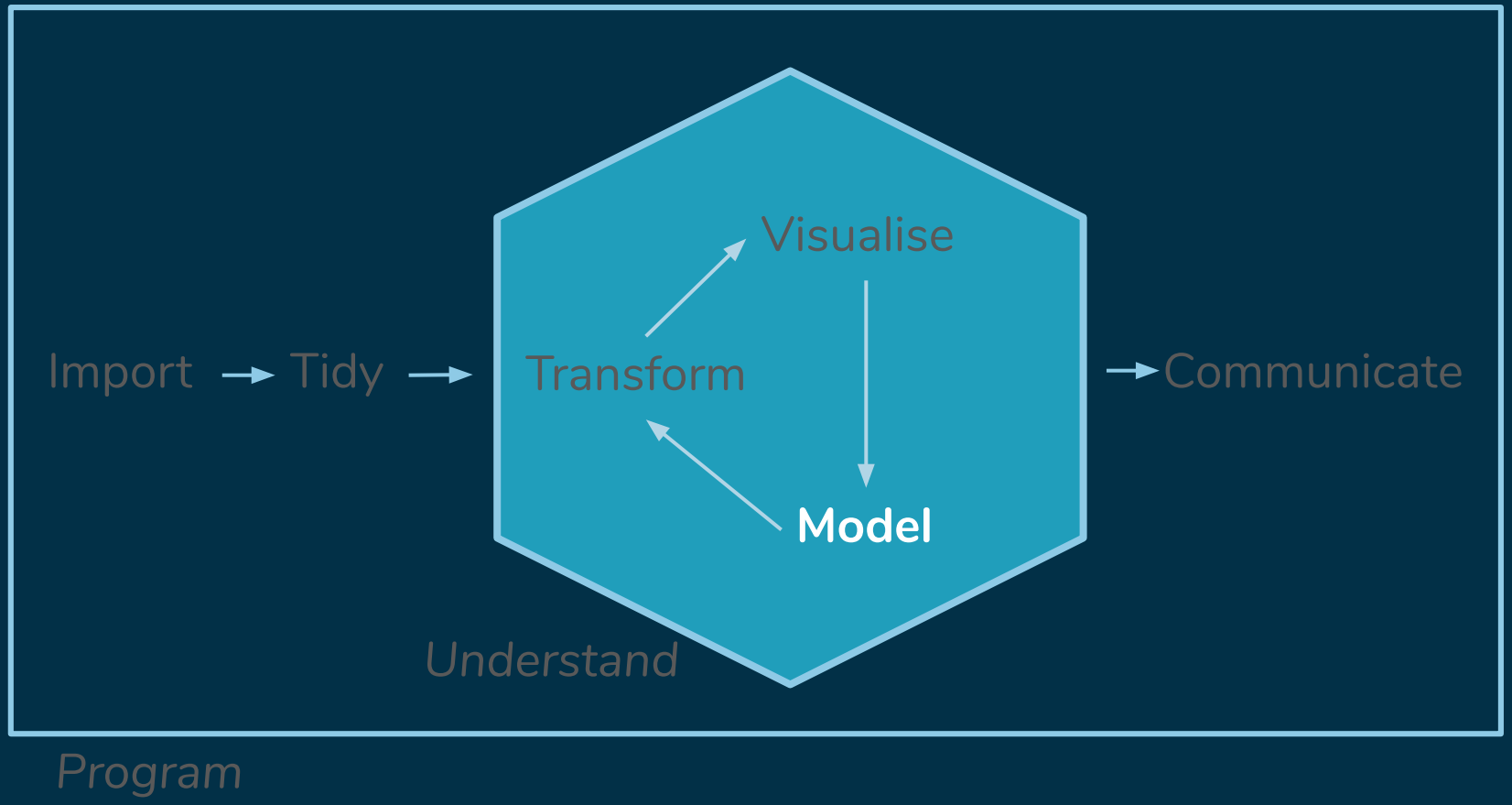



```
ggplot(mpg, aes(x = cty, y = displ)) +
  geom_point() +
  geom_line() +
  geom_smooth()
```

Let's do **practice**!

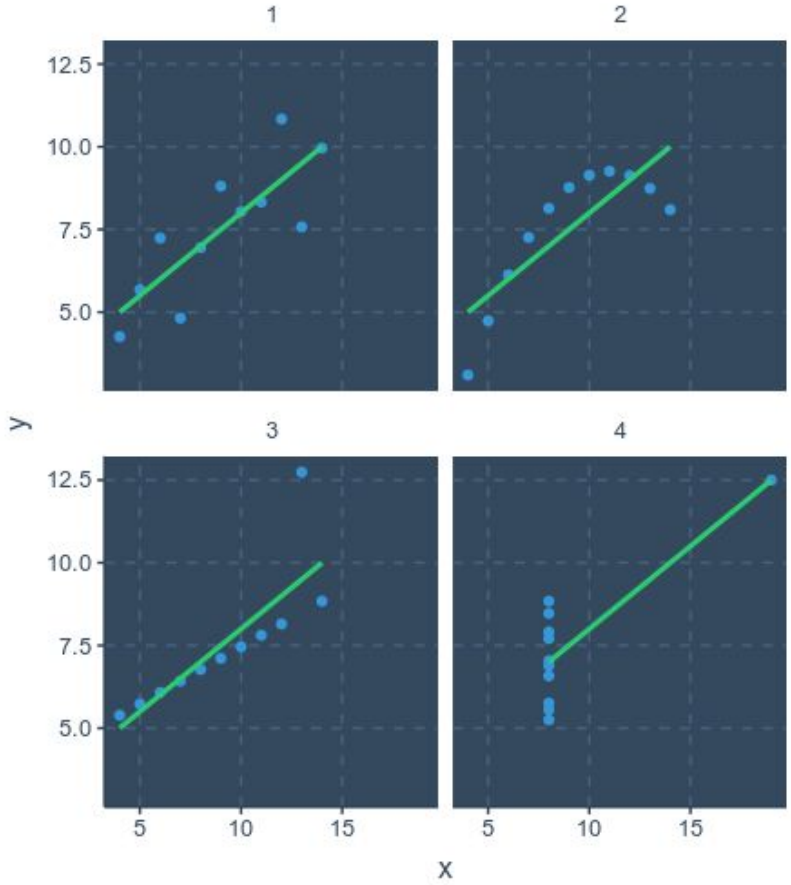
- Open 'm4_data-visualisation.Rmd'
- Do not forget to push your works into GitHub!


Import
Tidy
Transform
Visualise
Model
Communicate
Understand
Program


Import
Tidy
Transform
Visualise
Model
Communicate
Understand
Program

A low dimensional description of a higher dimensional data set

Source: https://github.com/rstudio-education/arm-workshop-rsc2019



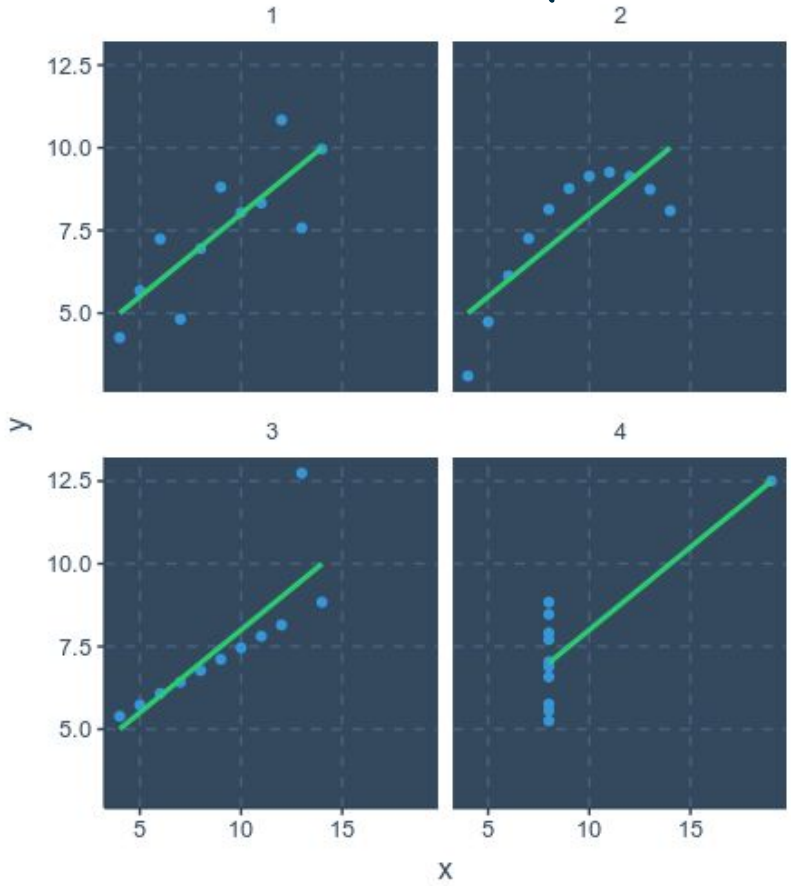
Outcome ~ Predictor/Explanatory

To predict

To explain

- All models are wrong, but some are useful – George Box

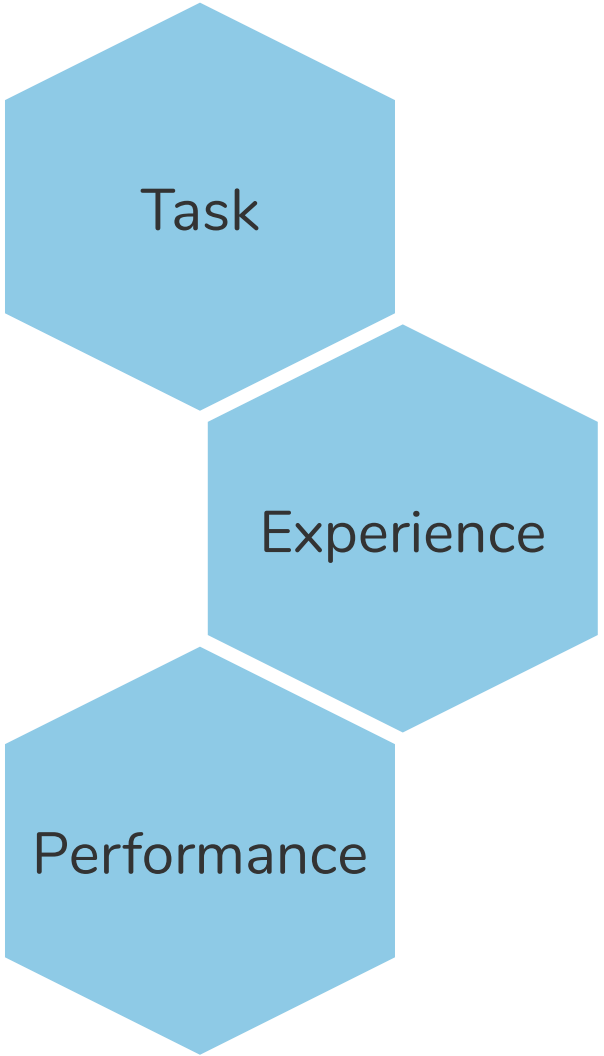
Anscombe's Quartet



Mean of x	9	exact
Sample variance of x	11	exact
Mean of y	7.50	to 2 decimal places
Sample variance of y	4.125	±0.003
Correlation between x and y	0.816	to 3 decimal places
Linear regression line	y = 3.00 + 0.500x	to 2 and 3 decimal places, respectively
R^2	0.67	to 3 decimal places

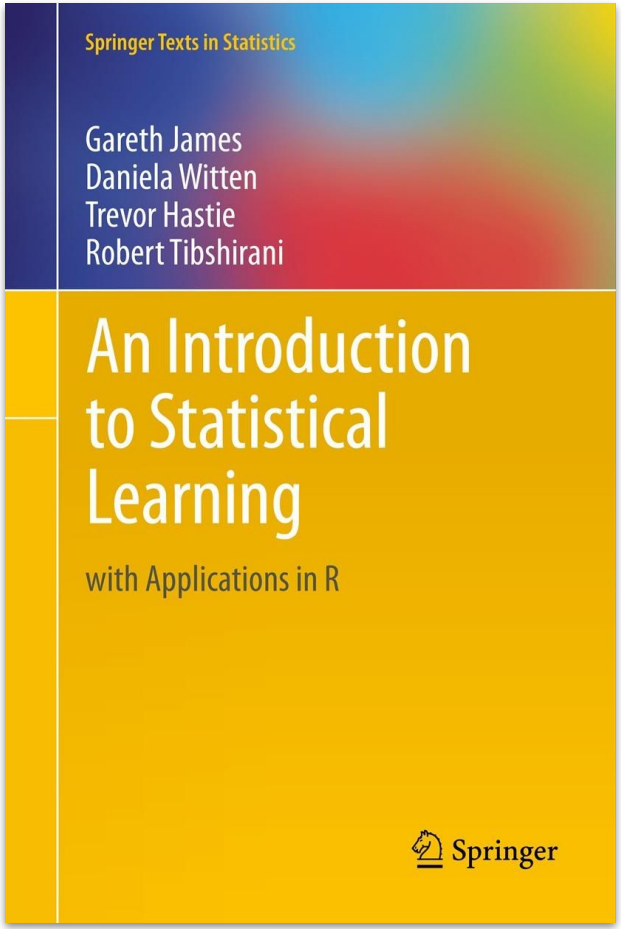
Machine Learning

$$y = f(x) + e$$



Supervised learning

Unsupervised learning



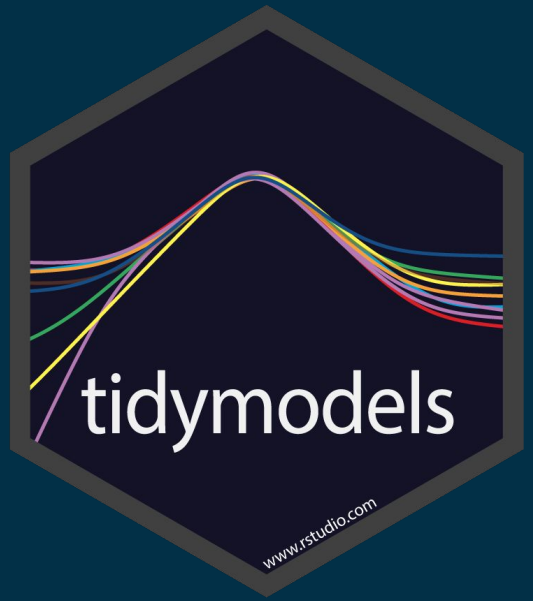
http://faculty.marshall.usc.edu/gareth-james/ISL/

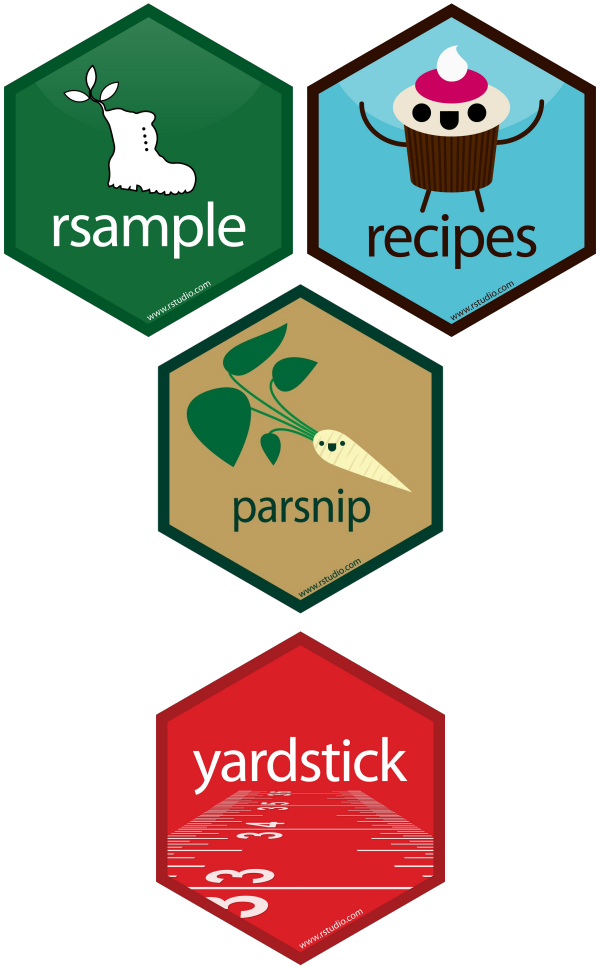
Pre-process

Train

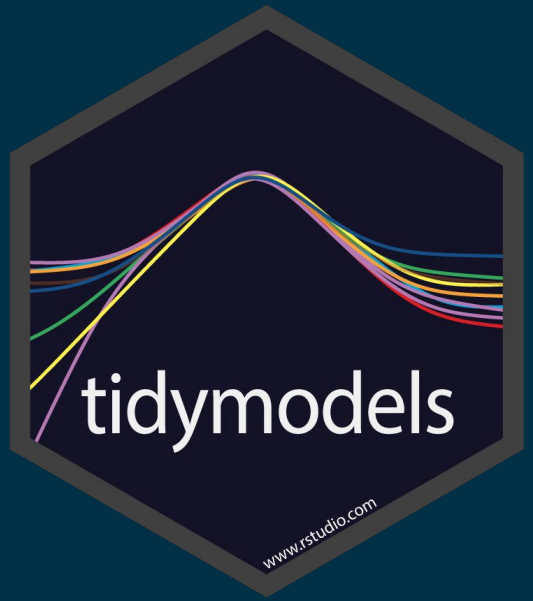
Validate

tidymodels




rsample
www.rstudio.com
recipes
www.rstudio.com
parsnip
www.rstudio.com
yardstick
www.rstudio.com

tidymodels

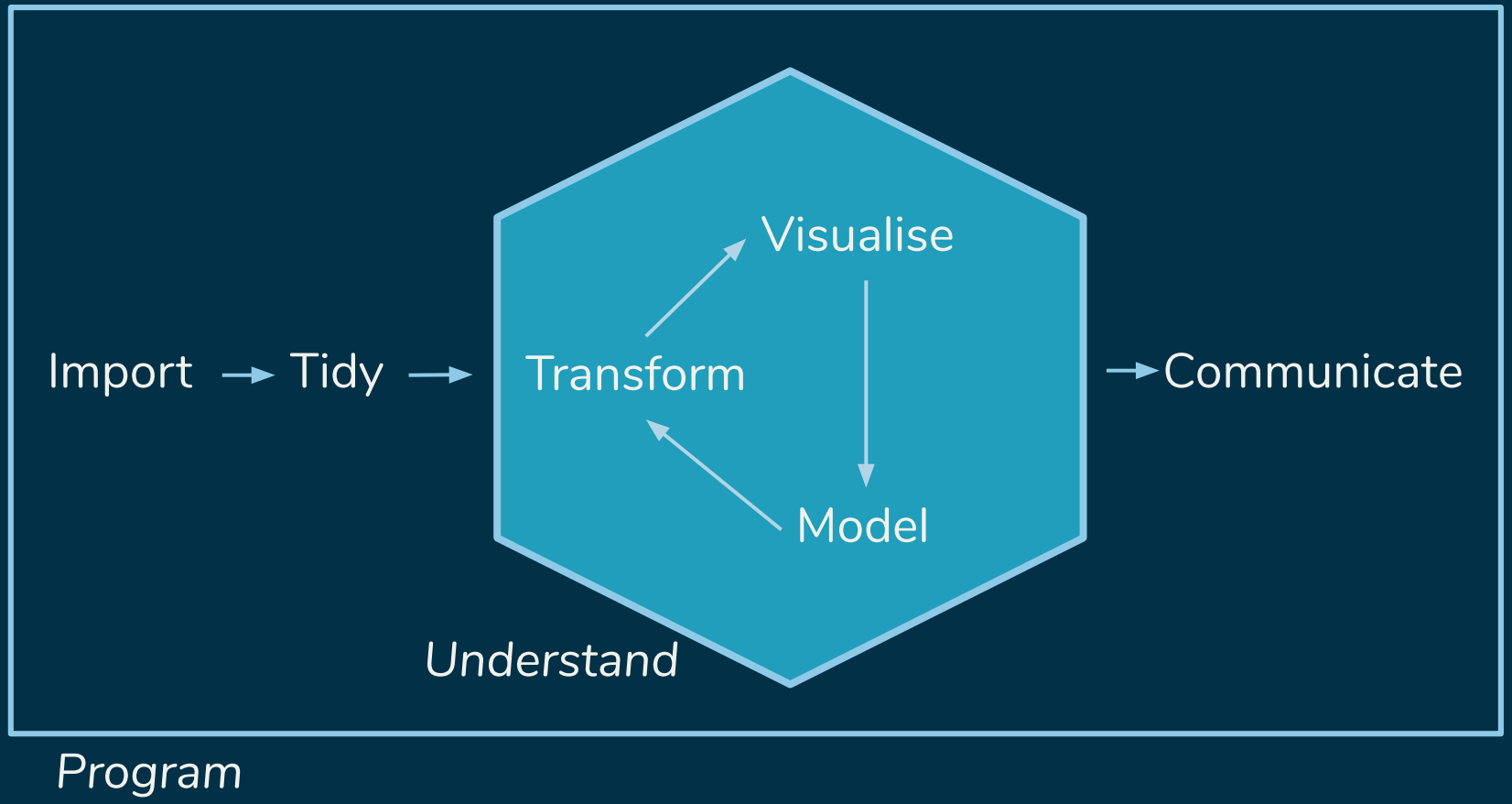

tidymodels
www.rstudio.com

Let's do **practice**!

- Open 'm5_model-1.Rmd'
- Do not forget to push your works into GitHub!

Let's do **practice**!

- Open 'm6_model-2.Rmd'
- Do not forget to push your works into GitHub!


Import
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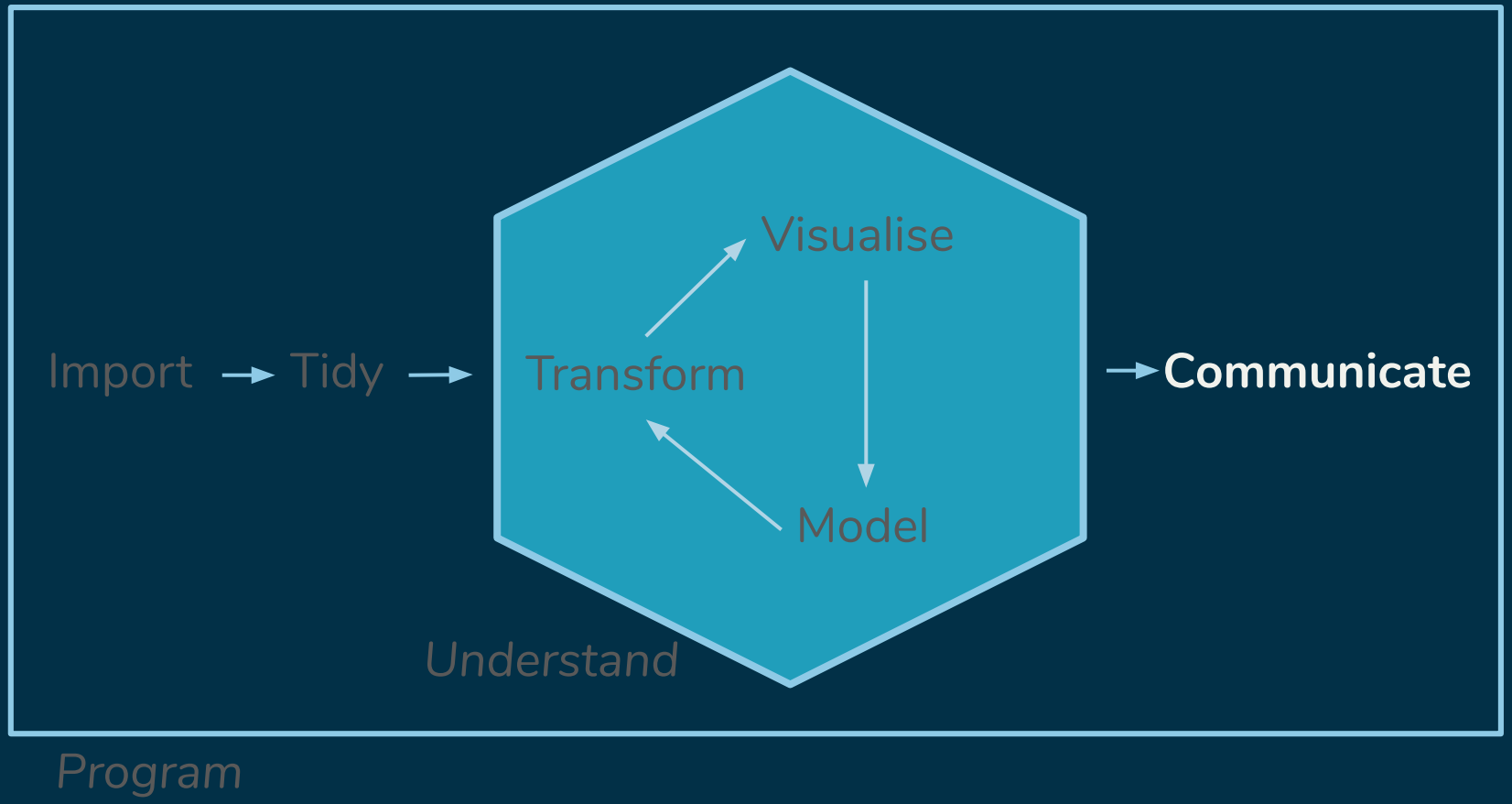
Program


Import
Tidy
Transform
Visualise
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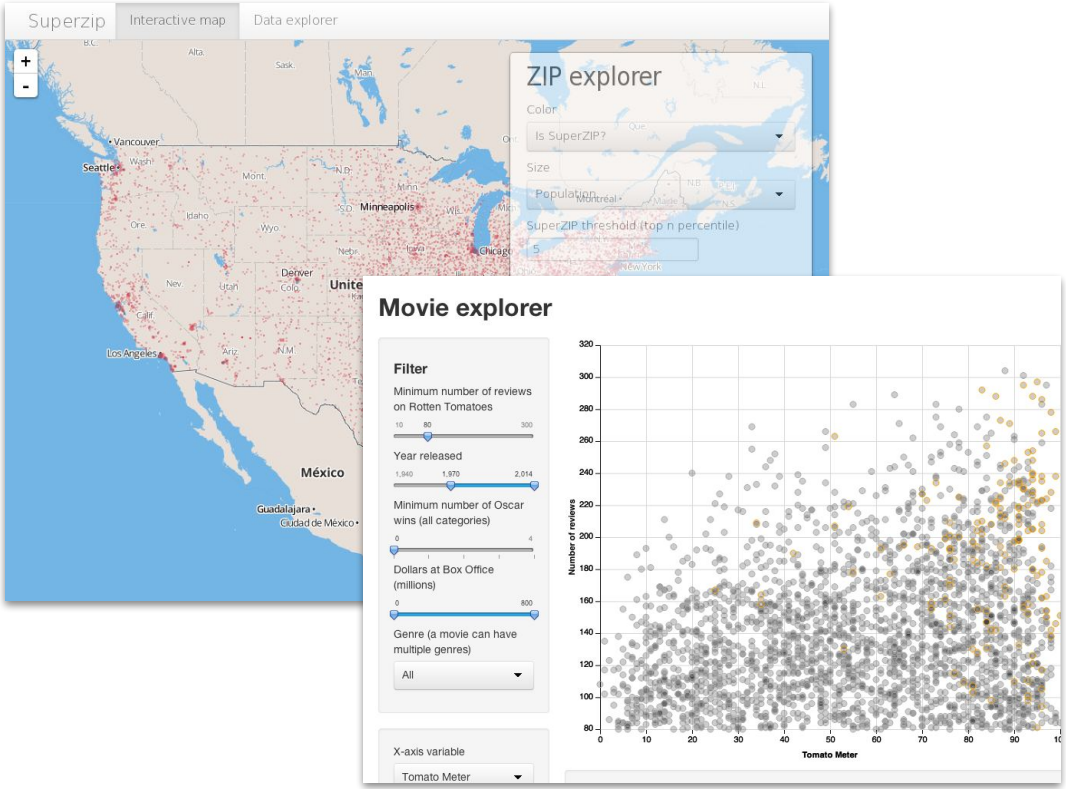
Program



Images from shiny.rstudio.com

shiny

Shiny

www.rstudio.com

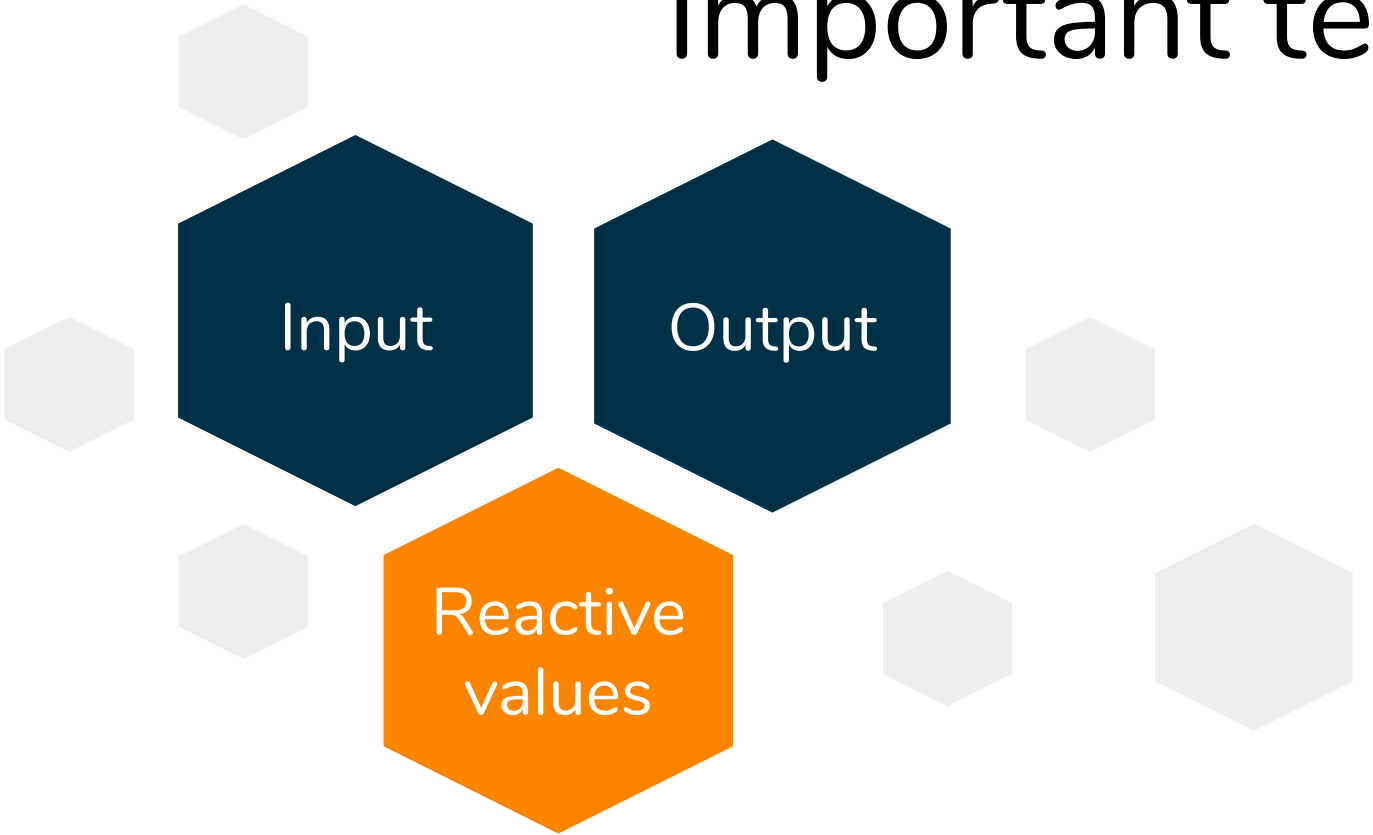
```
library(shiny)
mydata <- load(“mydata.rda”)

ui <- fluidPage(
# define user interface here
)

server <- function(input, output) {
# put logic and computation here
}

shinyApp(ui = ui, server = server)
```

Important terms!



```
library(shiny)
mydata <- load(“mydata.rda”)

ui <- fluidPage(
# define user interface here
)

server <- function(input, output) {
# put logic and computation here
}

shinyApp(ui = ui, server = server)
```

- Inputs are defined and laid out
- Outputs are laid out

- Inputs are taken
- Outputs are calculated/made

```
library(shiny)
mydata <- load("mydata.rda")

ui <- fluidPage(
# define user interface here
)

server <- function(input, output) {
# put logic and computation here
}

shinyApp(ui = ui, server = server)
```

1. Take input value from **input$xx**
2. Perform processing/calculation in reactive context (expression/observer)
3. Build objects to display using **render*()**
4. Save objects to display to **output$xx**

Let's do **practice**!

- Open 'm7_shiny-1.Rmd'
- Do not forget to push your works into GitHub!

Let's do **practice**!

- Open 'm8_shiny-2.Rmd'
- Do not forget to push your works into GitHub!

Congrats!

Artwork by @allison_horst

Contact me

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Phone: +62 822 3465 3816
Twitter: @aswansyahputra_